Service Manual

HUMACOUNT
&
HUMACOUNT Plus
Hematology Analyzer

Revision 3.0

Cat.-No.: 16400/2

CE

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1 INTRODUCTION

Since **HUMACOUNT PLUS** and **HUMACOUNT** have so much common characteristics, we cover both instruments in a common Service Manual. Information herein applies for both analyzers unless otherwise noted.

To be well up in the instruments, **please read this manual carefully** to have the knowledge for servicing the instruments perfectly and avoid extra costs and wasting precious time.

This **HUMACOUNT PLUS/HUMACOUNT Service Manual** contains the functional descriptions of both analyzers, the operation of the fluidic systems, the adjustments and settings and very important information for the Service Personnel about the service operations and possible problems.

1.1 Name and serial number

Name: **HUMACOUNT PLUS/HUMACOUNT** Hematology Analyzer

Serial No.: Every instrument has its own serial number, which is printed on the rear panel label and it can be read out from Device Information or from the Self test submenu. This serial number is write protected by HUMAN.

1.2 Intended use

HUMACOUNT PLUS/HUMACOUNT hematology analyzers are fully automated cell counters for *in vitro* diagnostic use. The compact instruments were developed for small to medium size labs.
HUMACOUNT PLUS can process 60, **HUMACOUNT** can process 30 samples per hour and they are intended to determine the following 18 hematology parameters from a 25 µl whole blood sample:

- WBC – LYM# - MID# - GRA# - LYM% - MID% - GRA% (three-part WBC differential)
- HGB – RBC – HCT – MCV – RDW – MCH – MCHC
- PLT – MPV – PCT – PDW

1.3 Integrated software

The integrated software controls the instrument operations, displays, stores, recalls data, and allows the User to perform QC and calibration procedures and modify the user settings. The software version number can be read out from the Device Information or from the Self test submenu.

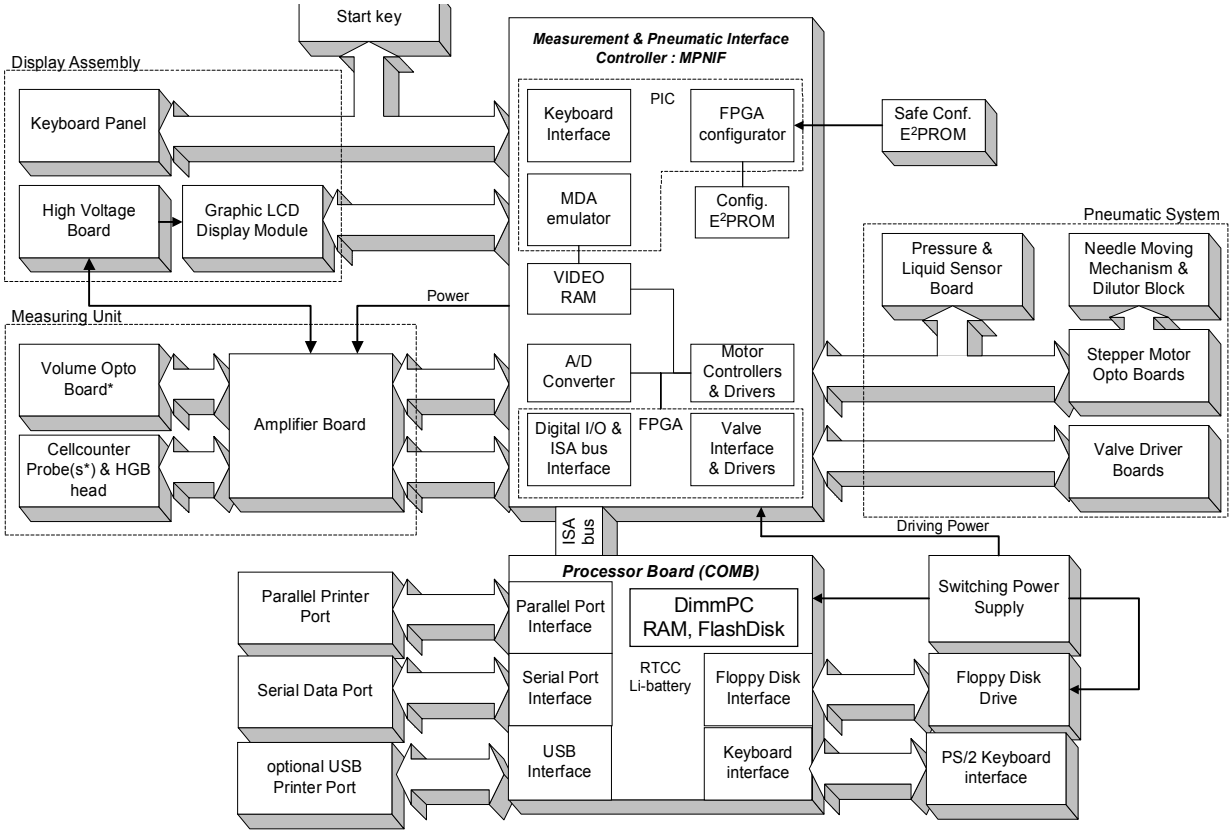
Instrument software (V1.7 and above) is absolutely *"Plug and Play"*, it can detect what type of instrument is used and it will control the analyzer according to the hardware, without any user or service help. Every **HUMACOUNT PLUS/HUMACOUNT** software version can be updated by the latest release available from HUMAN.

2 FUNCTIONAL DESCRIPTION

2.1 Main electronic parts of the analyzers

HUMACOUNT PLUS/HUMACOUNT Hematology Analyzers consist of the following electronic parts:

1. Cellcounter Probe(s)
2. HGB Head
3. Volume Opto Board – only for **HUMACOUNT PLUS**
4. Amplifier Board
5. Measurement & Pneumatic InterFace Card (MPNIF)
6. Safe configuration E^2PROM board
7. High Voltage Board
8. Graphic LCD Display Module
9. Keyboard Panel
10. Start key & glowing LED
11. Pressure & Liquid Sensor Board
12. Stepper Motor Opto Boards
13. Valve Driver Boards
14. Switching Power Supply
15. MB4 Main Board with DimmPC
16. Floppy Disk Drive
17. Parallel Port (optional USB printer port)
18. Serial Port

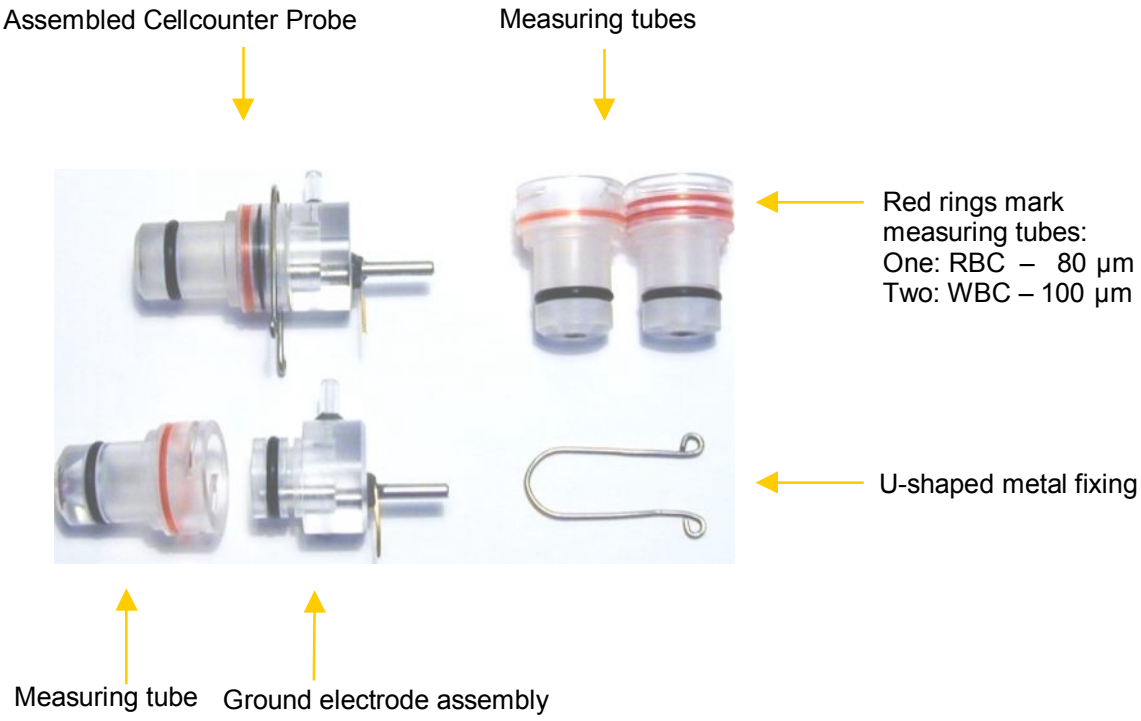


***HUMACOUNT PLUS/HUMACOUNT** Electronic Functional Block Diagram*

2.1.1 Cell-counter Probes

Impedance method is used for determination of volume and number of cells. In this method a known volume of dilution is drawn through a small aperture. Constant current is passed through the aperture from one side to the other. When a cell passes through the aperture, it causes a change in resistance, which generates a voltage pulse.
The amplitude of the voltage pulse is proportional to the ratio of cell volume per aperture volume. This is used to determine the volume of cells. The number of cells can be obtained by counting the pulses.

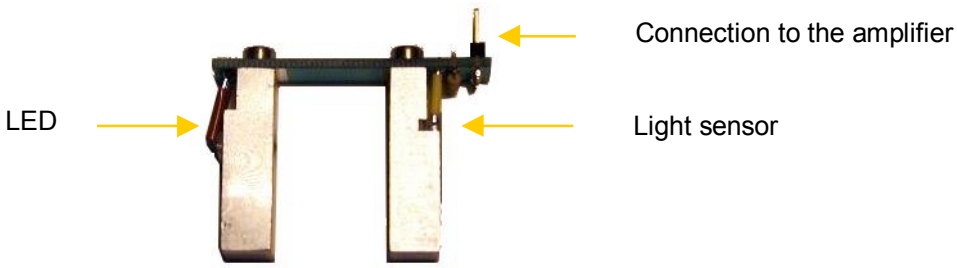
- In the **HUMACOUNT PLUS** there are two Cellcounter Probes: WBC probe with 100 µm aperture, and RBC probe with 80 µm aperture. Both have a ground electrode assembly and U-shaped metal fixing as it is shown in the next figure.
- In the **HUMACOUNT** there is only one Cellcounter Probe: the aperture size is 80 µm – this is the same as the RBC probe in the **HUMACOUNT PLUS**.



The aperture is made of ruby and it is moulded into the measuring tube. The correct sealing around the aperture is very important for measurements.

2.1.2 HGB Head

Hemoglobin head is placed at the bottom of the WBC chamber in the **HUMACOUNT PLUS,** and at the bottom of the measuring chamber in the **HUMACOUNT**. It contains: light source (LED) at 540 nm and Photo Detector (TSL235). The Photo Detector converts the light to frequency. The HGB concentration is a logarithmic function of this frequency measured by the FPGA circuit of the MPNIF card.



HUMACOUNT PLUS makes four kinds of HGB measurements (diluent measurements are performed on diluent reagent):

- Sample dark measurement (before WBC counting)
- Sample light measurement (before RBC counting)
- Diluent light measurement (in WBC washing phase)
- Diluent dark measurement (immediately after the previous one)

The HGB result is calculated from these measurements by:

$$HGB \cong \log [(CNT_{diluentlight} - CNT_{diluentdark}) / (CNT_{samplelight} - CNT_{sampledark})]$$

HUMACOUNT does not perform any dark measurements (it is always zero), so this equation is simpler:

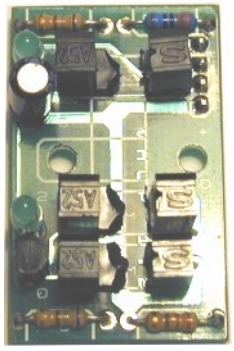
$$HGB \cong \log (CNT_{diluentlight} / CNT_{samplelight})$$

Do not open or close the instrument door during any measurement cycle, because this may cause error in HGB measurement. Normally, door should be closed during real measurements.

2.1.3 Volume Opto Board

This board is present only in HUMACOUNT PLUS.

It contains three opto switches which make possible to measure a constant volume of the diluted sample with a special float. The volume opto board is connected to the amplifier board through the VM connector (on the other side of this board).



Measurement is made between OM1 and OM3 – no LED on, (OM2: gate opto is for bubble error prevention).

The upper LED is lit, when the float is between the OM1 sensor.

The lower LED is lit, when the float is between the OM2 sensor, but OM3 sensor is not

2.1.4 Amplifier Boards

HUMACOUNT PLUS and HUMACOUNT amplifier boards are different PCBs, but there are a lot of common functional parts on them.
Common functional parts: amplifier board includes its own voltage regulator, the connection interfaces for HGB head, for high voltage board and for MPNIF card.

In this board there is the current generator circuit, which works from 50 V measuring voltage (coming from high voltage board) and the probe (DC) voltage is amplified with a voltage follower (output: ELV). Nominal measuring current is **870 µA**.

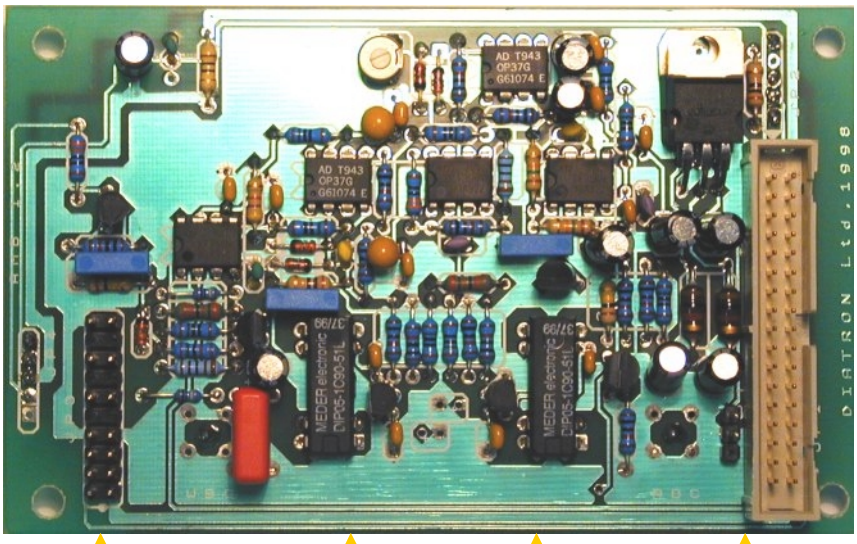
The amplifier board includes the main 3-stage amplifier channel, which amplifies the input signal to the 0...5 V range (this is the input range of the A/D converter, which is on the MPNIF card). The offset voltage is set by P1 potentiometer by the manufacturer. **Adjust the offset voltage only in case it is out of the +/- 5mV range.**

The test circuit makes possible to generate test pulses (with TEST and PLS signals through FETs) for checking the proper operation of the amplifier channel.

HUMACOUNT PLUS amplifier board includes also the connection (JP2) for volume opto limiter.

In this board there are two reed relays on the input side: IC10 can select between the two channels (RBC, WBC) with RSW signal; IC11 connects high voltage (from high voltage board) to the selected probe with HSW signal.

The DHON signal (from the MPNIF card) switches on the LED in the HGB head via a transistor (Q3), but the Photo Detector in the HGB head is working continuously.

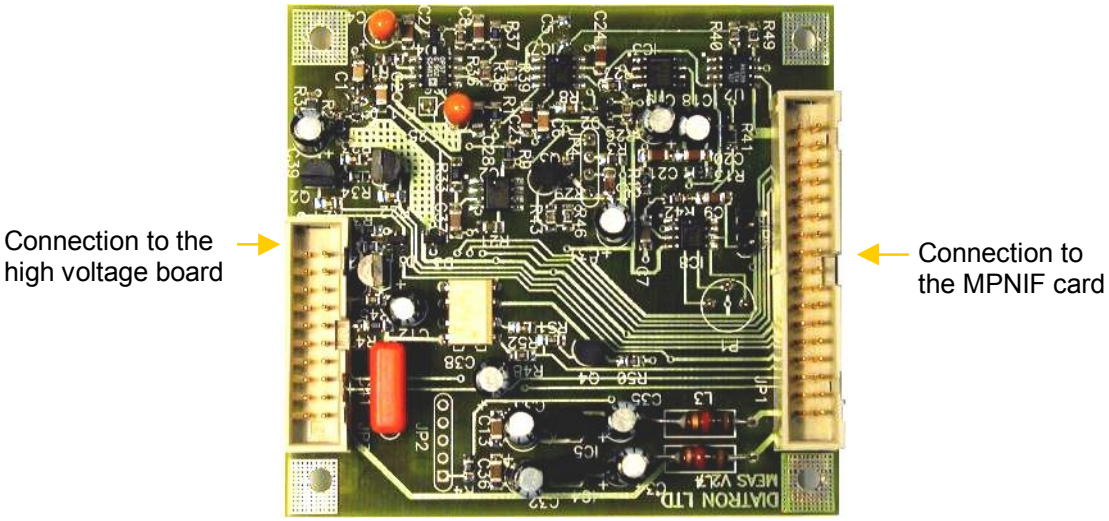


HUMACOUNT amplifier board includes only one input connector for the chamber.

In this board there is no relay in the input stage, but there are two opto switches (U1, U3: TLP627) to connect high voltage (from high voltage board) to the probe with HSW signal and isolate the input of the amplifier.

The RSW signal changes the gain (RBC, WBC) in the feed back of the second amplifier stage with U2 (MAX319) analog switch.

The DHON signal (from the MPNIF card) switches on the LED and also the Photo Detector in the HGB head via a transistor (Q3) that is why there is no dark HGB value in **HUMACOUNT**.



The other side of the amplifier boards includes special connectors for the chamber(s) and connector for the HGB head (JP4).

2.1.5 Measurement & Pneumatic Interface Card (MPNIF)

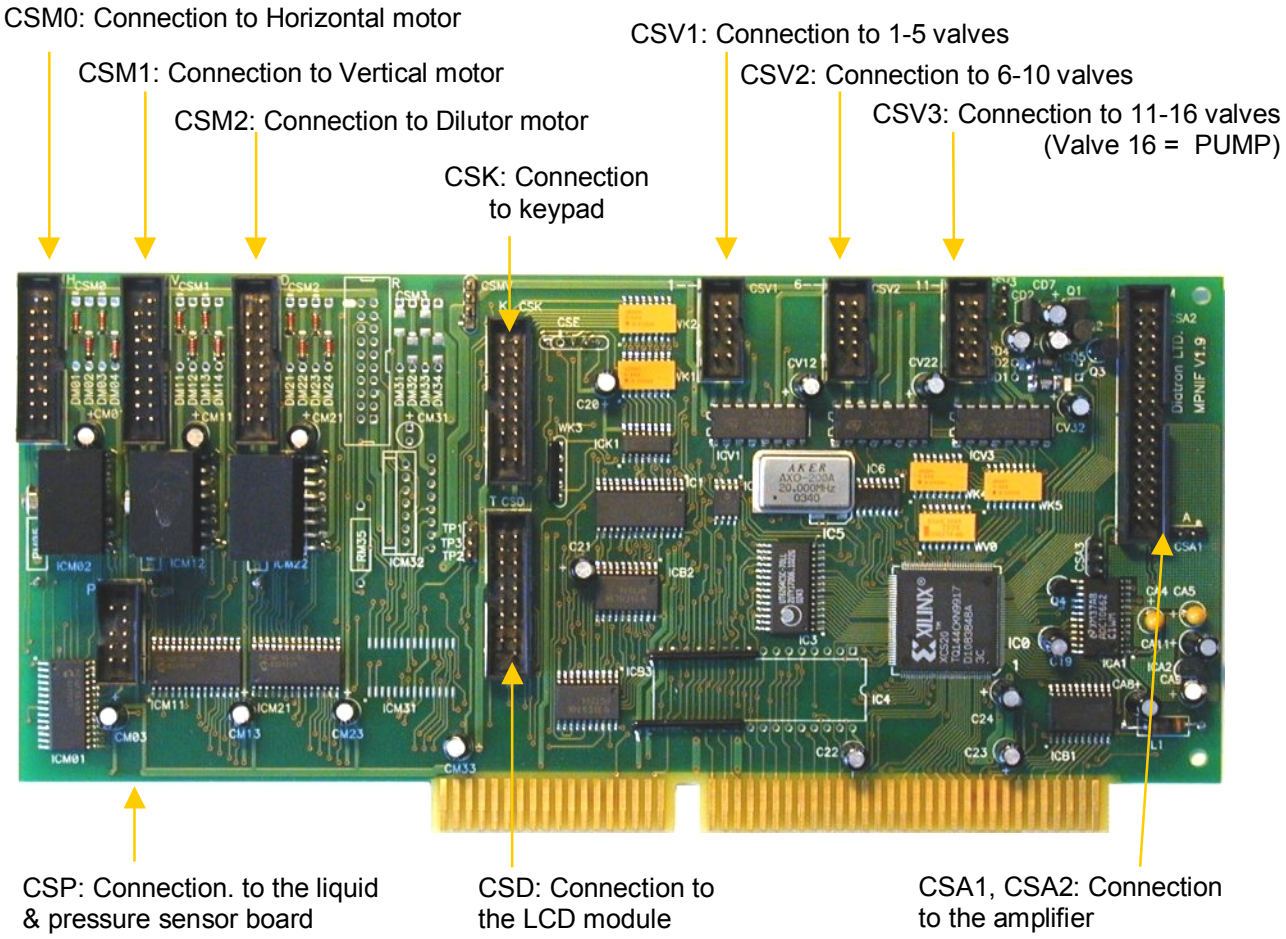
MPNIF card incorporates measurement processing, and also the pneumatic, display and keyboard functions in one board.

In addition, this card has an **MDA** (monochrome display adapter) emulation mode, which allows the Service Person to use the LCD like a computer monitor or checking the proper operation of the instrument's main board.

The controller card is connected to the main board through the ISA bus. After power on the card holds the main board in wait state (with –IOCHRDY signal) until the **PIC** (micro-controller) configures the FPGA circuit from the configuration E^2PROM located on the card, or from the safe E^2PROM, located on the IDEPROM board. After that the **FPGA** makes the I/O and memory address decoding and selects the actual part placed on the board:

- Video RAM for MDA (Monochrome Display Adapter) emulation and Graphics
- Card controller PIC
- Motor controller PICs (micro-controllers, controlling stepper motors)

The FPGA circuit also performs the main measurement data sampling and communication tasks. The board's A/D chip with its own sample/hold circuit makes the analog to digital conversion. After that the FPGA makes the data processing and stores the results in a temporary FIFO memory. The results are sent to the PC main board by DMA cycles.
With the internal registers of the FPGA the software can control the valves, the digital interface of the amplifier and the controller PIC. The PIC makes displaying (even greeting screen at start-up) and keyboard scanning, after the loading the configuration into FPGA.


CSM0: Connection to Horizontal motor
CSM1: Connection to Vertical motor
CSM2: Connection to Dilutor motor
CSK: Connection to keypad
CSV1: Connection to 1-5 valves
CSV2: Connection to 6-10 valves
CSV3: Connection to 11-16 valves (Valve 16 = PUMP)
CSP: Connection. to the liquid & pressure sensor board
CSD: Connection to the LCD module
CSA1, CSA2: Connection to the amplifier

2.1.6 Safe configuration E^{2}PROM board (IDEPROM)

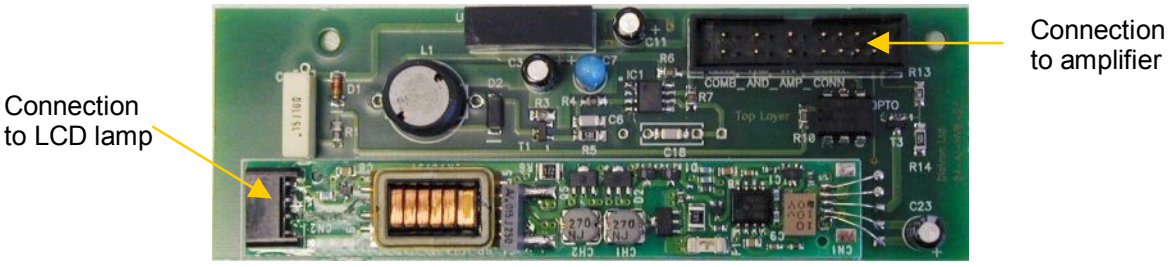
This board contains a 24FC256 serial E^{2}PROM, which stores the FPGA's configuration data, Safe greeting screen and identity information about the instrument. Keeping the hardware identity information (OEM information, model version: HUMACOUNT PLUS/HUMACOUNT) the IDEPROM makes possible to run the correct software (HUMACOUNT PLUS or HUMACOUNT) and store the instrument's serial number.

The IDEPROM is connected to the MPNIF card and it is write protected.

The data of the normal configuration E^{2}PROM on the MPNIF card can be modified by the software, allowing to change the FPGA functions. If there is any problem (e.g. power off) during this overwriting process, the instrument will start in "Safe mode" (this is displayed on the LCD) and the FPGA will be configured from the Safe E^{2}PROM (IDEPROM card).

2.1.7 High Voltage Board (HVB)

High Voltage Board generates the backlight voltage (300Vrms, 180 kHz) for CCFL (cold-cathode fluorescent lamp) of the LCD, the aperture cleaning voltage (150Vdc), and the measuring voltage (50Vdc). The high voltage board is connected to the system through the amplifier board and the MPNIF card.
This unit contains INVC191 inverter, which is a high voltage, high frequency circuit producing suitable voltage for CCFL of the LCD.



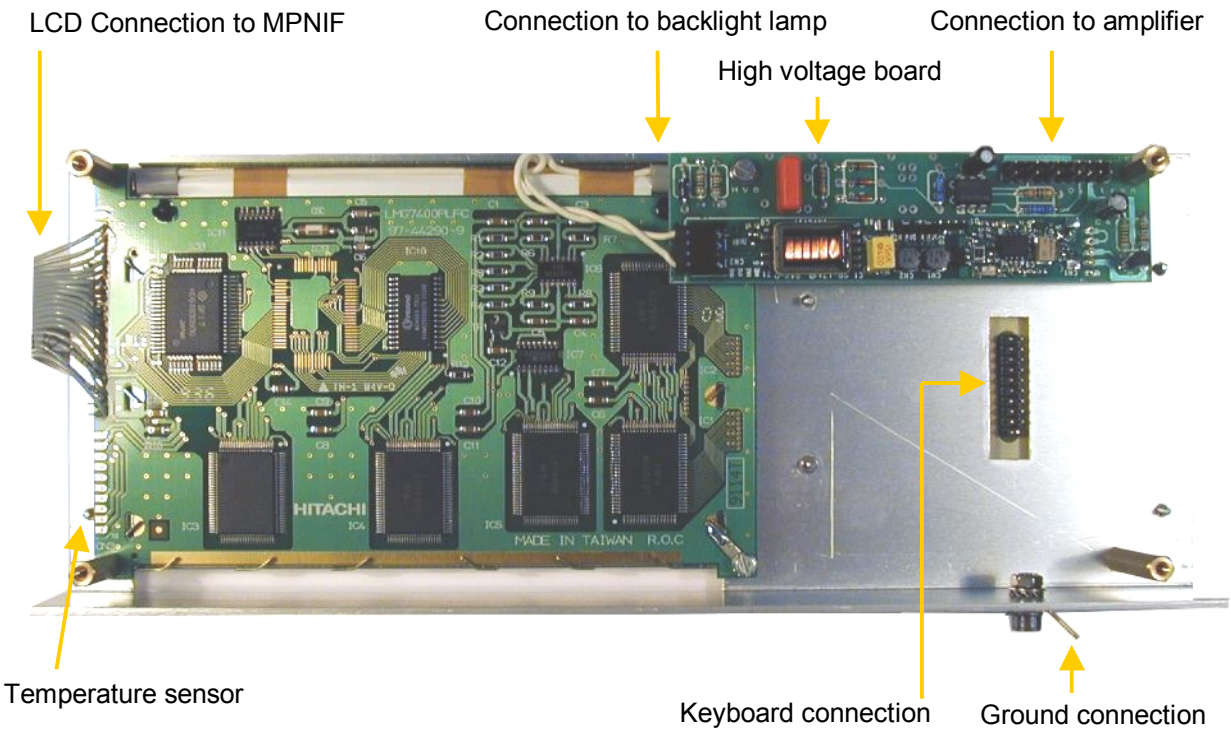
The CFSW digital signal (from the MPNIF card) controls the high voltage board, if it is high (1) the inverter is off, if it is low (0) the inverter is on.
The MVON digital signal (from the MPNIF card) switches the measuring voltage (50 Vdc) on/off by an opto switch.

Warning! Be careful with servicing this board in active state, because the high voltage (300V) at LCD lamp connector can cause damages or electric shock.

Never operate the analyzer without the LCD backlight connected to the HVB, because the over-voltage on the output of the HVB can damage the HVB board and the amplifier.

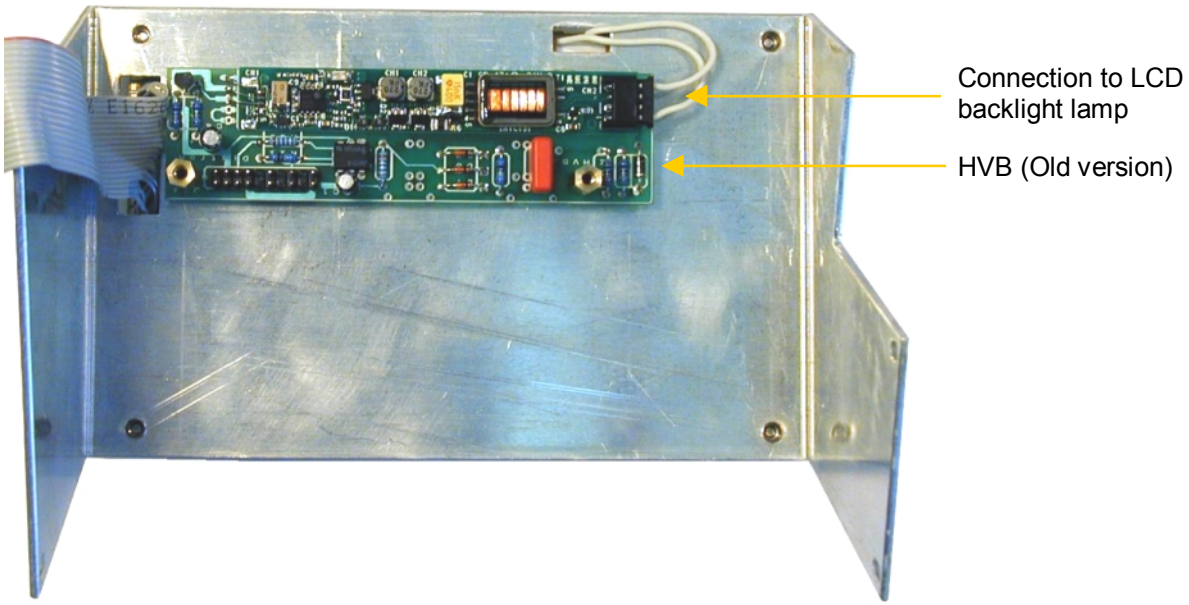
2.1.8 Graphic LCD Module

This module contains 240x128 dots LCD display (HITACHI LMG7400PLFC or SP14N002), the HVB and this is the back panel of the keyboard module. LCD has a high voltage backlight lamp (the high voltage board generates the required voltage).



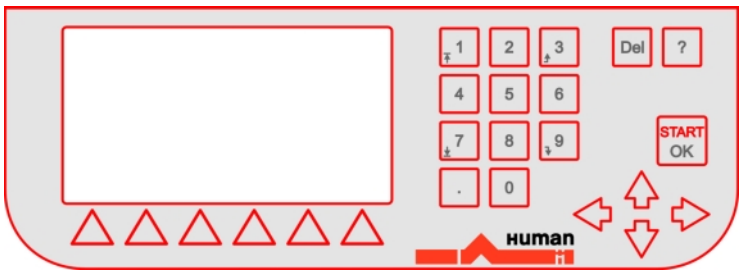
*LCD assembly of **HUMACOUNT PLUS***

In the **HUMACOUNT** the HVB is fixed onto the LCD display holding frame:



In the LCD module and on the MPNIF card there is a special temperature compensation circuit, which makes possible to use the LCD module in wide temperature ranges with the adjusted contrast.

2.1.9 Keyboard Panel



The analyzer has a 24-button foil keyboard including numerical keypad (0...9, .), cursor moving and OK buttons, Delete and Help (?) keys and 6 function buttons, under the LCD display as it is shown in the figure below (**HUMACOUNT** keyboard panel):

2.1.10 Start key & glowing LED

The Start key is a micro switch, connected to the MPNIF card (through the K&L ribbon cable). The glowing LED indicates the actual status of the analyzer and it has three colors: red, green and amber (See User's Manual). The LED has three pins and the actual color depends on the controlled pins. The LED is also connected to the MPNIF card through the K&L ribbon cable.

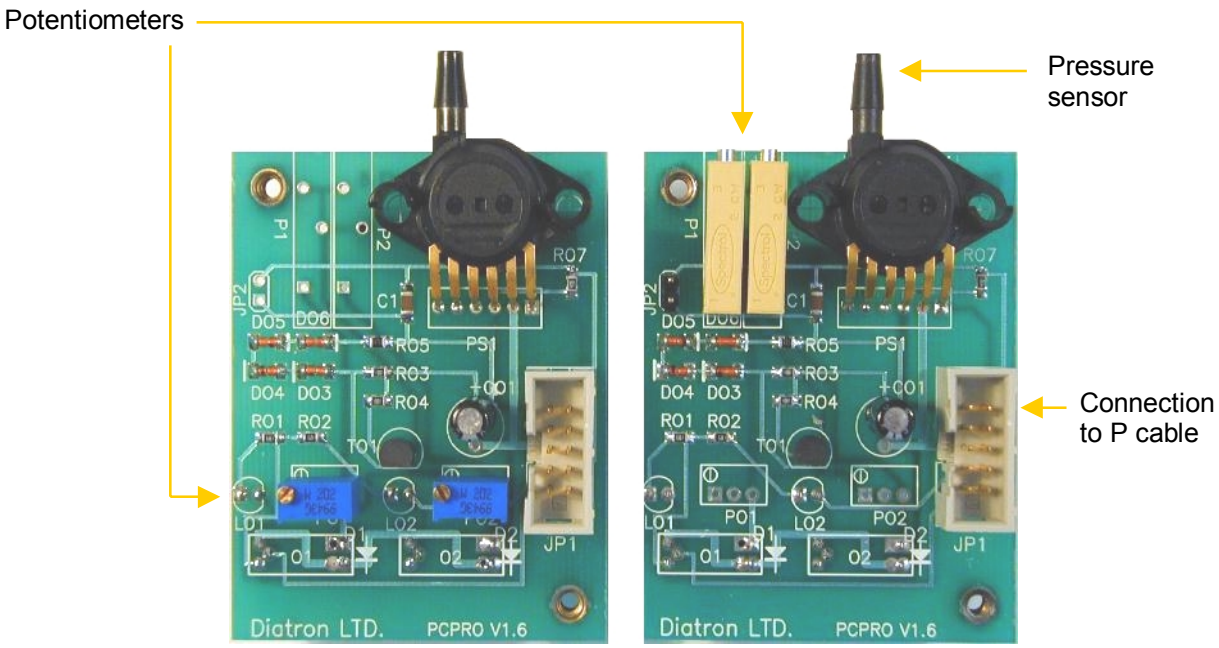
2.1.11 Pressure & Liquid Sensor Board (PCPRO)

This board contains MPX5100AP calibrated pressure sensor, which can measure the pressure of air. It has two liquid detectors, for sensing diluent/cleaner and lyse reagents.

There are two potentiometers to adjust the sensitivity of both liquid sensors, but in different position for **HUMACOUNT PLUS** and **HUMACOUNT** (see the pictures below). The potentiometer on the left is for the Diluent/Cleaner, the one on the right is for the Lyse detector sensitivity. The PCPRO board is connected to the MPNIF card through the P ribbon cable.

On the other side of the board there are two liquid detectors with indicator LEDs which show the actual state of the sensors: the corresponding LED is on if no reagent in the tube.

HUMACOUNT PLUS & HUMACOUNT PCPRO

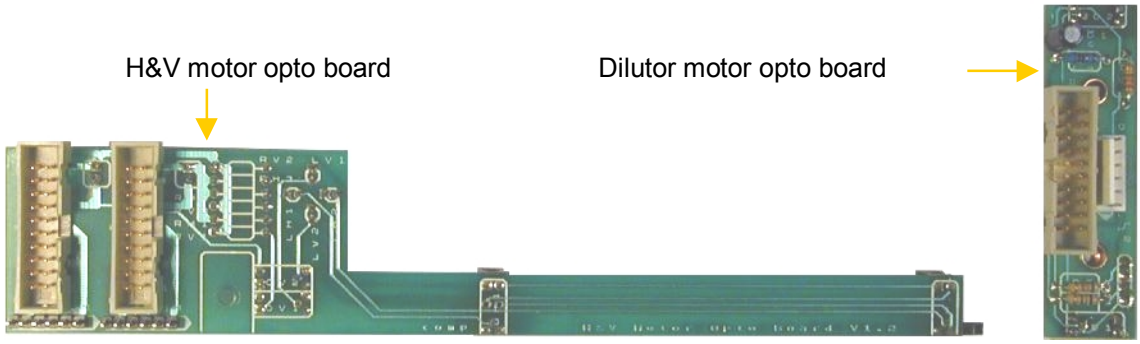


The pressure sensor tolerates maximum +5 V and it has the same power voltage as the opto sensors have. Do not connect higher voltage than +5 V to this board because it can damage the pressure sensor.

2.1.12 Stepper Motor Opto Boards

There are three stepper motors in the system: Horizontal and Vertical motors, which make the movements of the aspirating tip moving carriage, and Dilutor motor, which moves the three syringes (macro, lyse, micro). The stepper motor opto boards make the connections between the motor controller PICs and motors, and have opto switches for the motor's end and home positions. The actual status of the stepper motor's optos is indicated by two LEDs on both stepper motor opto boards.

H&V motor opto board connects to the horizontal and vertical stepper motors and to the MPNIF card (through HM and VM ribbon cables). On the other side of this board, there are four opto switches of the two stepper motors positions (home and end for both) and its own indicator LEDs.



Dilutor motor opto board contains the opto switches of the dilutor motor, which moves the syringes in the fluidic system and the connection between the motor and the DM ribbon cable (from the MPNIF card). On the other side of the board there are two opto switches (home and end switches) and their own indicator LEDs.

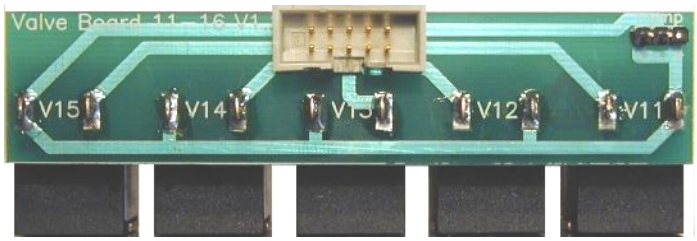
2.1.13 Valve Driver Boards

In the **HUMACOUNT PLUS** there are three kinds of different valve driver boards:

- Valve board 1-5
- Valve board 6-10
- Valve board 11-15 & pump

In the **HUMACOUNT** there are only two kinds of valve driver boards:

- Valve board 1-5
- Valve board 11-15 & pump

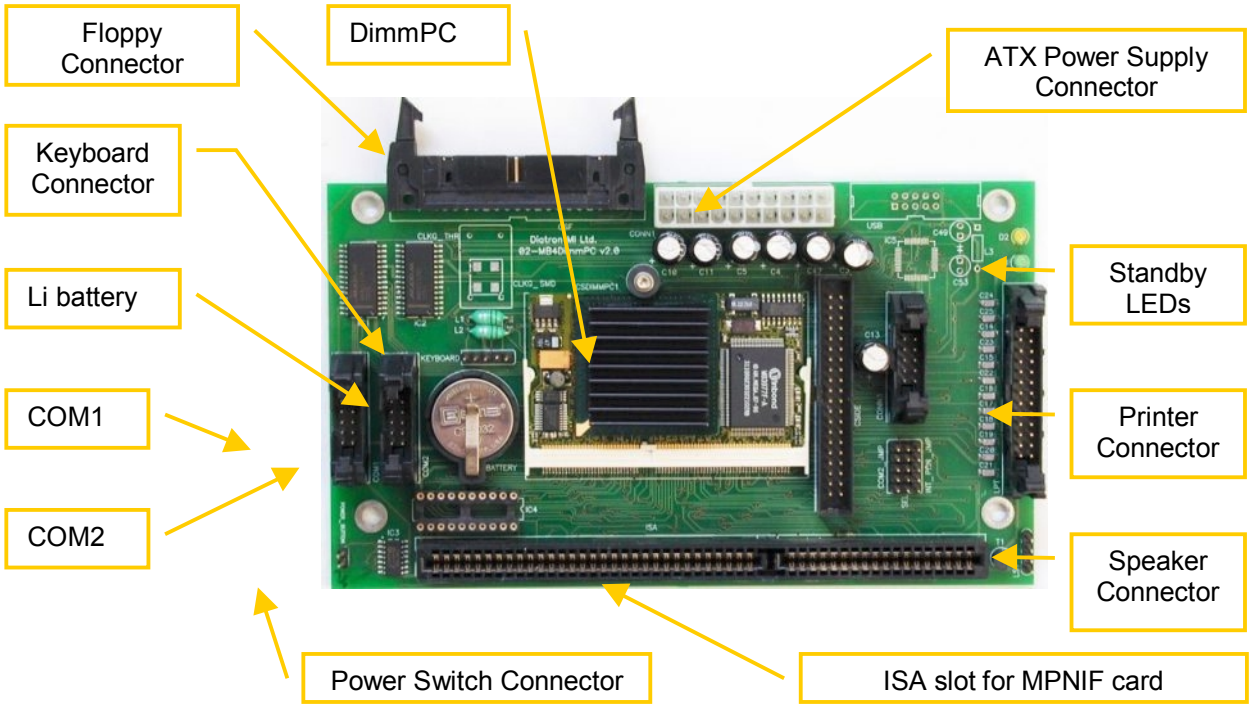


The Valve 11-15 driver board contains the MO connection to the Pump unit.

The valve driver boards are connected to controller chips located on the MPNIF card through A, B and C ribbon cables. (In **HUMACOUNT** there is no B cable). These boards control the valves in 5-valve sets.

2.1.14 Main Board (MB4)

The analyzer works with a main board called **MB4**. Required settings of MB4 board and BIOS setup values are detailed in Chapter 6.



MB4 board contains the necessary connectors for the different resources, and an ISA slot for the MPNIF board. There is a 3V Li-battery to feed Real-Time Clock and Calendar (RTCC) chip during power down.

Floppy disk drive is connected to the MB4 with a ribbon cable. The required configuration of the floppy disk drive (boot sequence) can be set in the Boot priority section of the BIOS settings.

Video adapter (MDA: Monochrome Display Adapter) and **video memory** are placed on the MPNIF card. In MDA mode the instrument displays the text monitor output on the LCD.
Two LEDs are indicating the state of power on MB4 main board:

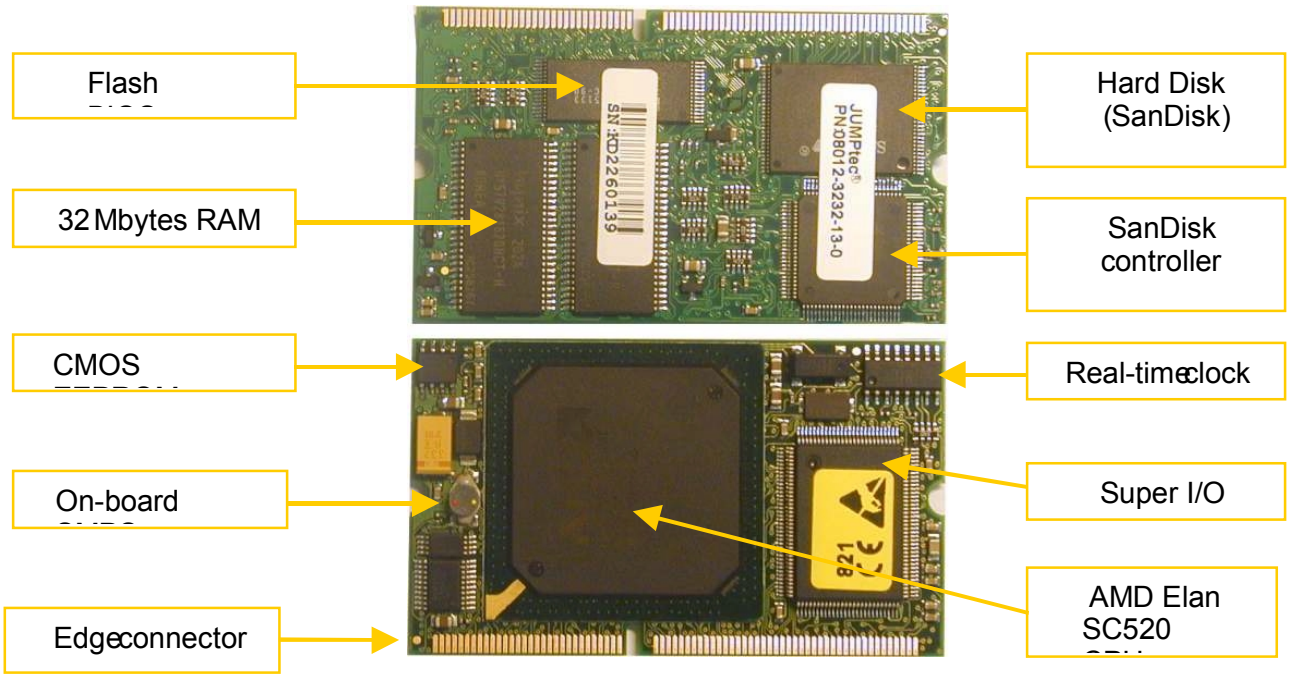
1. Green LED is on, if external power is present (stand-by mode),
2. Yellow LED is on, if power is turned on.

Always remove external power, or turn off power switch on the power supply if you remove or replace components (e.g. DimmPC, MPNIF, MB4 main board, etc.

2.1.15 DimmPC Module

The MB4 board incorporates a credit-card sized PC, named **DimmPC***. The processor on the DimmPC is a 133MHz Pentium-class core, with 32Mbytes on-board RAM, and 32Mbytes on-board SanDisk. This is the HDD (hard disk drive) of the analyzer, so instrument software with all user settings, calibration, database, etc. is stored on the DimmPC.

** DimmPC® is the Trade Mark of Kontron Embedded Modules GmbH*



2.1.16

2.1.17 Switching Power Supply

The analyzer works with a standard, 200 or 230VA ATX type PC switching power supply. The power supply has its own internal fuse and a built in fan. The most frequent problem is the malfunction of the fan, so check and clean it regularly. The power supply has a temperature sensor, which can detect overheating and shut down the power.

2.1.18 Floppy Disk Drive

The built in Floppy Disk Drive makes possible to save data on floppy disks, and to install (or upgrade) the software.
I normal case (and for SW upgrade), the boot device priority should be Hard Drive then Floppy drive in BIOS Setup. In this case, the analyzer starts up from SanDisk.

Boot Device Priority submenu – for Normal operation:

+ Hard Drive
+ Removable Devices

If you need to boot from Floppy disk, set up the following boot order. In this case it is possible to boot from an external floppy disk, containing bootable code (e.g. MS-DOS). You can refer to the floppy disk as A:, SanDisk will be C:.

Boot Device Priority submenu – for booting from a bootable floppy disk:

+ Removable Devices
+ Hard Drive

2.1.19 Parallel and USB Printer Ports

The “Printer” port located on the rear panel is for external printers with parallel port.
The USB port is an option. If DimmPC is equipped with USB module, and at least SW V3.0 is installed the analyzer supports USB printer connection.

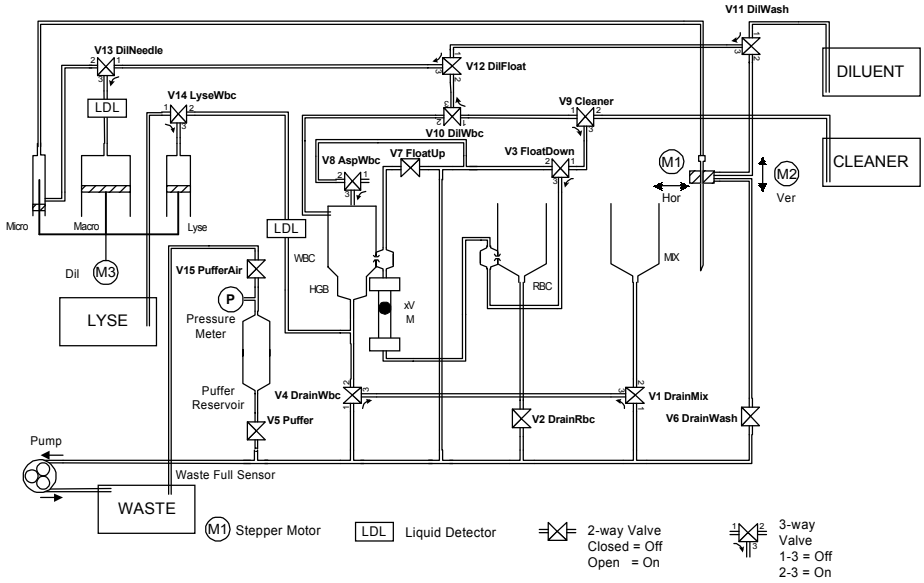
2.1.20 Serial Port

The Serial port is a standard RS232 V24 port with the standard pin-out. COM1 – marked “Serial” can be used is useful for communication with a host computer.

2.2 Main mechanic and fluidic parts of the Analyzer

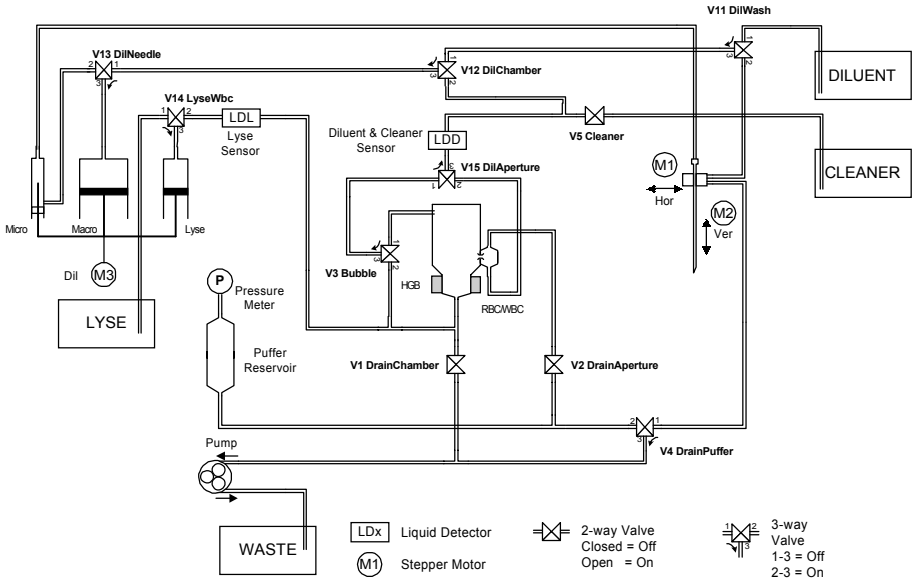
HUMACOUNT PLUS/HUMACOUNT Hematology Analyzers consist of the following mechanic and fluidic parts:

1. Dilutor
2. H&V moving unit
3. Volume meter tube (xVM) – only for **HUMACOUNT PLUS**
4. Pump
5. Aspirating tip
6. Chamber(s*)
7. Valves (1-5, 6-10*, 11-15)
8. Washing head
9. Puffer reservoir
10. Tubing



HUMACOUNT PLUS *Fluidic Schematics*

HUMACOUNT *Fluidic Schematics*

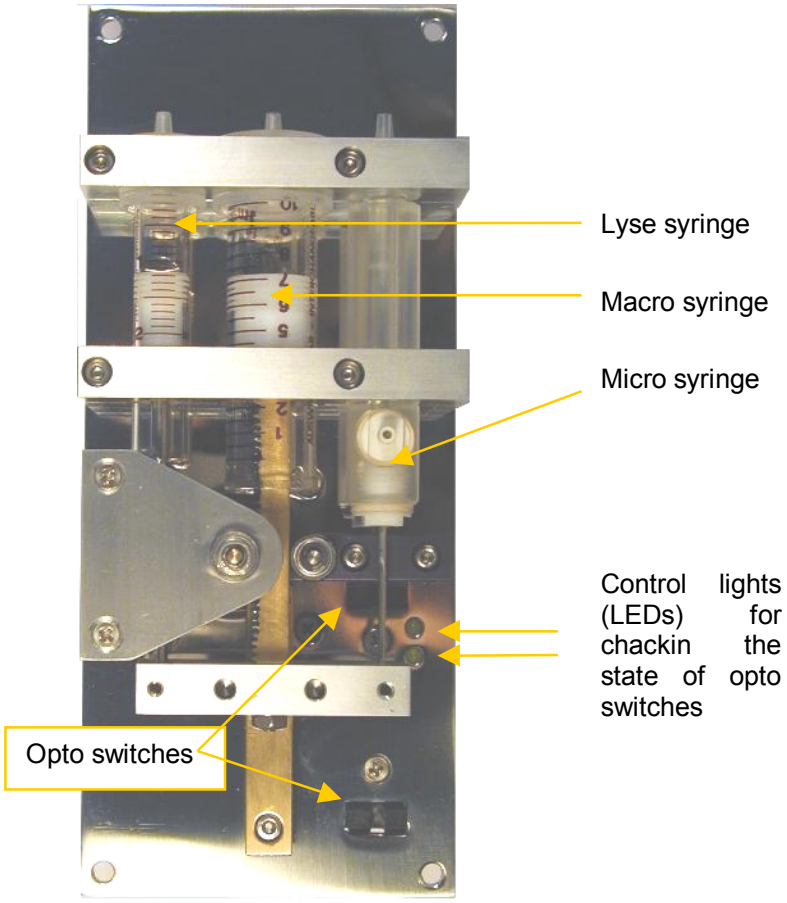


2.2.1 Aspirating tip

The aspirating tip is assembled in the H&V moving unit and it makes the sample aspirations. The right setting of the aspirating tip is necessary and very important (see Chapter Adjustments).

2.2.2 Dilutor

This unit is the same for both instruments (**HUMACOUNT PLUS** and **HUMACOUNT**) and includes the dilutor stepper motor, the dilutor motor opto board, three syringes and the piston rods with special transmission. The dilutor motor opto board is on the other side of this unit.
The picture below shows the **HUMACOUNT PLUS/HUMACOUNT** dilutor module with the three separated syringes.



The dilutor block is operated by a stepper motor, which is connected to the motor opto board. The motor opto board has home & end position opto switches. The optical home/end position switches are operated by a small tag fixed on the moving part. The principle is the interruption of infra-red light emitted by the diode of the sensor. The control lights (LEDs) are showing the actual state of the sensors: if the light is on, the dilutor moving part reached the corresponding sensor.

HUMACOUNT PLUS/HUMACOUNT dilutor module works with separated syringes (glass for Macro and Lyse; plexiglass for Micro). Macro syringe is for diluent reagent, Lyse syringe is for lyse reagent, and the Micro syringe is for precision sampling during measurement.

Maintenance should be provided to the piston tips, by applying neutral silicon grease to the cogged end of the Macro and Lyse pistons, between the syringe and the tip itself. This will ensure optimum sealing and longer lifetime of piston tips.

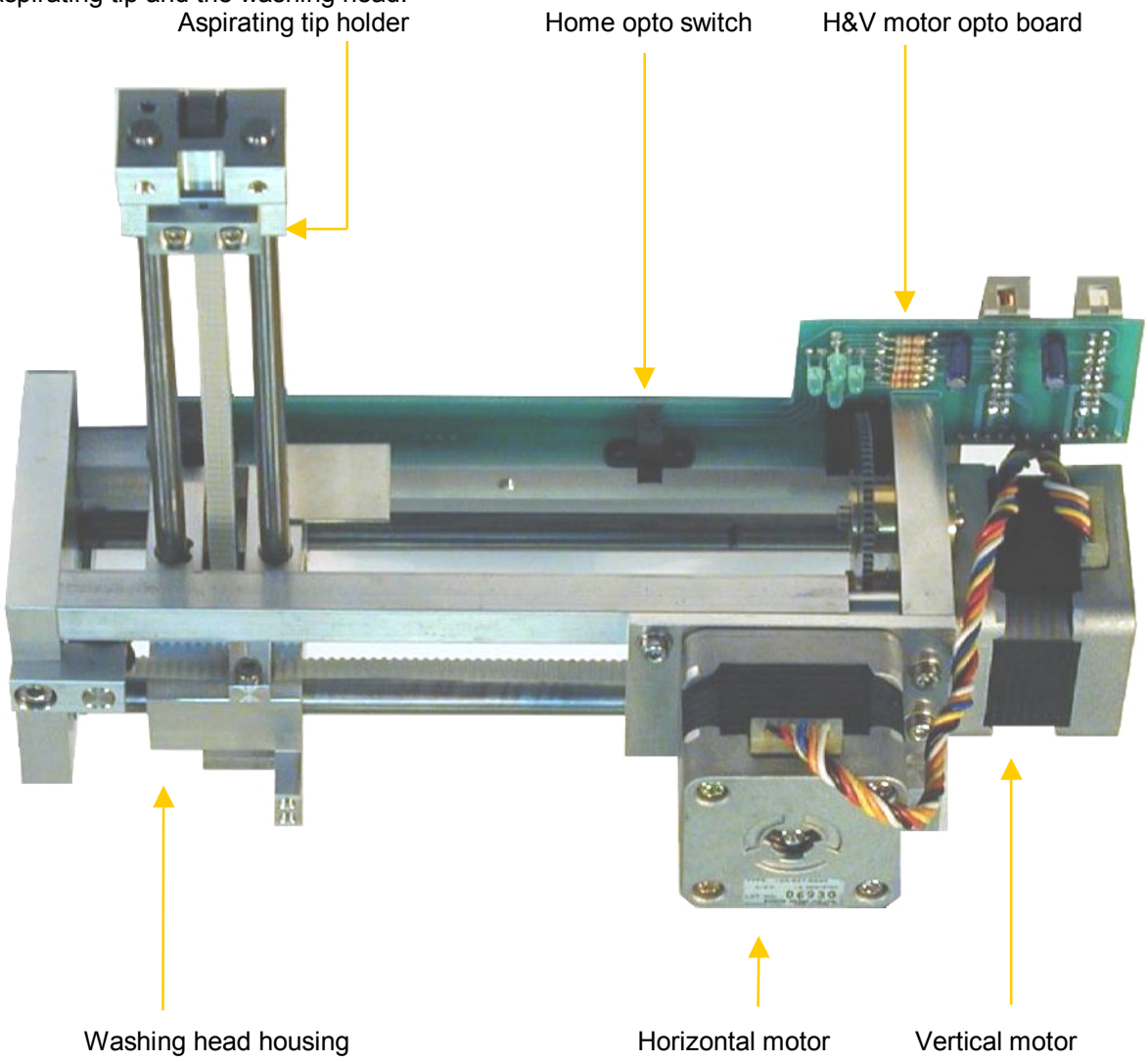
Greasing of the cogged transmission parts (cogwheel and cogged bar) should be done regularly using machine grease.

It is recommended to check and repeat greasing of piston tips, and transmission gear every year, or after 10000 measurements.

2.2.3 H&V moving unit (XY)

This unit is the same for both instruments (**HUMACOUNT PLUS** and **HUMACOUNT**) and it contains the Horizontal and Vertical stepper motors, H&V motor opto board, opto wheel and the special mounting.

This moving unit moves the aspirating tip holding carriage and in the assembled analyzer it includes the aspirating tip and the washing head.



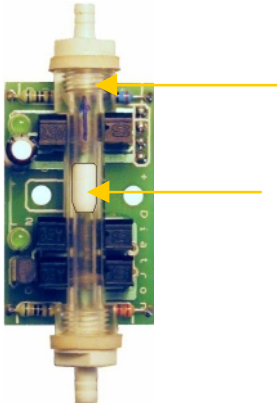
The Vertical motor works with a special opto wheel for detecting home & end positions. See the adjustment section of this manual to place this wheel to the proper position.

Greasing of the horizontal/vertical guiding rods should be done regularly using "Photorub", a PTFE-based thin lubricant.

It is recommended to check and repeat greasing of guiding rods every year, or after 10000 measurements.

2.2.4 Volume Meter Tube (xVM) – HUMACOUNT PLUS only

The volume meter tube (xVM) is mounted on the volume opto board (see photo).



The tube contains a float, which is moved up by diluent flow before counting.

During counting, first it comes down, the measurement is started when the top LED goes off, and the movement of the float is proportional to the volume of WBC dilution measured. Counting stops when bottom LED goes on.

RBC counting is performed when the float goes upwards (none of the LEDs are on).

The arrow on the tube must point upwards when replacing tube.

Do not mix up the float direction during cleaning of the tube, because the chamfering is not symmetrical, and the float may block the tube. The long, small angle chamfer must face to the bottom of the tube.

2.2.5 Peristaltic Pump

The pump generates the regulated vacuum and drains the fluidic system. The pump is connected to the Valve 11-15 driver board (MO connection) and the control chip located on the MPNIF card, which drives this unit. The pump is operated from 12Vdc.

If the tube of the peristaltic pump becomes worn, it can be broken, causing Pressure error.

It is recommended to check the state of the tube, and replace it every 2 years, or after 20 000 measurements.

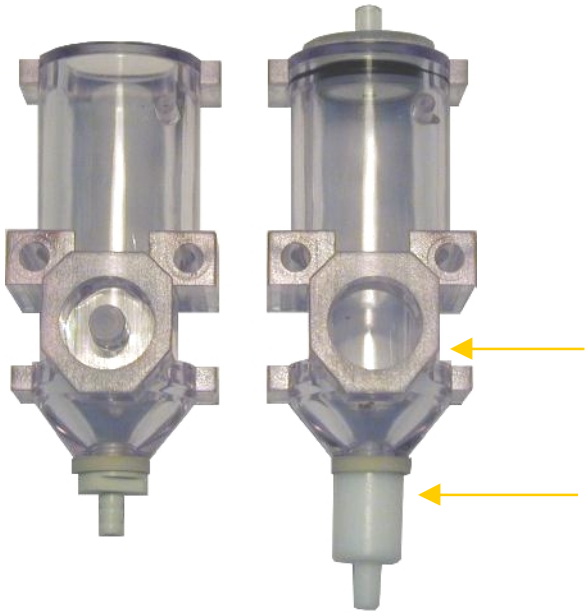
Always replace the peristaltic pump tube to the same PharMed® type, with the same length.

For servicing the tube of the pump, open the peristaltic pump from its top (see picture) and remove the tube together with the white plastic side wall (see picture):

In case of damaged tubes, it can be replaced by a new one by opening the two metal locks located at the two ends of the tube (see picture).

2.2.6 Chamber(s*)

In the **HUMACOUNT PLUS** there are three different chambers made of polycarbon. The MIX chamber is for the first sample dilution. The RBC and the WBC chambers are mounted with the cell counter probes.



The chamber on the left is an **HUMACOUNT PLUS** MIX chamber, it is closed from the front and it is open at the top.

The chamber on the right is an **HUMACOUNT PLUS** WBC chamber with the hole in the front for the cellcounter probe. It is closed at the top and it has the special WBC long PTFE draining connector.

In the **HUMACOUNT** there is only one chamber for diluting and measuring the blood cells. This chamber is the same as the WBC chamber in the **HUMACOUNT PLUS** with the long draining connector but it is open at the top – and it has an extender cap on it.

It is extremely important for both instruments that these chambers should have no damage or crack because it could cause erroneous measurements (noise).

2.2.7 Valves (1-5, 6-10*, 11-15)

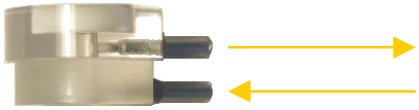
There are two kind of pneumatic valves in the system:

- 2-way Valve
- 3-way Valve

Valves are assembled in a unit of five on the valve blocks.
HUMACOUNT PLUS contains 3 of these boards (15 valves), **HUMACOUNT** has only 2 valve blocks (10 valves).

2.2.8 Washing head

Washing head is located at the bottom of the H&V moving unit and it is for cleaning the outer surface of the aspirating tip. This washing process is made by diluent reagent and the fluid is drained by the pump. The arrows on the picture show the direction of diluent flow.



It is recommended to check the state of the washing head at regular service visits.

Clean or replace it yearly, or after 10 000 measurements.

2.2.9 Puffer reservoir

The puffer reservoir insures the stable vacuum during the measuring process. **HUMACOUNT PLUS** and **HUMACOUNT** puffer reservoirs **are** made by glass but in **different** sizes. The figures of these units are shown on the assembled analyzers section of this manual.

2.2.10 Tubes

The fluidic system contains tubes, which have different diameters and lengths and also made by different materials.
Reagent paths requiring perfect sealing are made of Tygon tubing, the draining circuit is made of silicon.
The Tubing Schematics Section contains the parameters of the tubes (length & diameter).

It is recommended to check the state of the tubing – especially lyse path – regularly, during service visits.

Run a complete bleaching cycle, check or replace tubing and fittings yearly, or after

10 000 measurements.

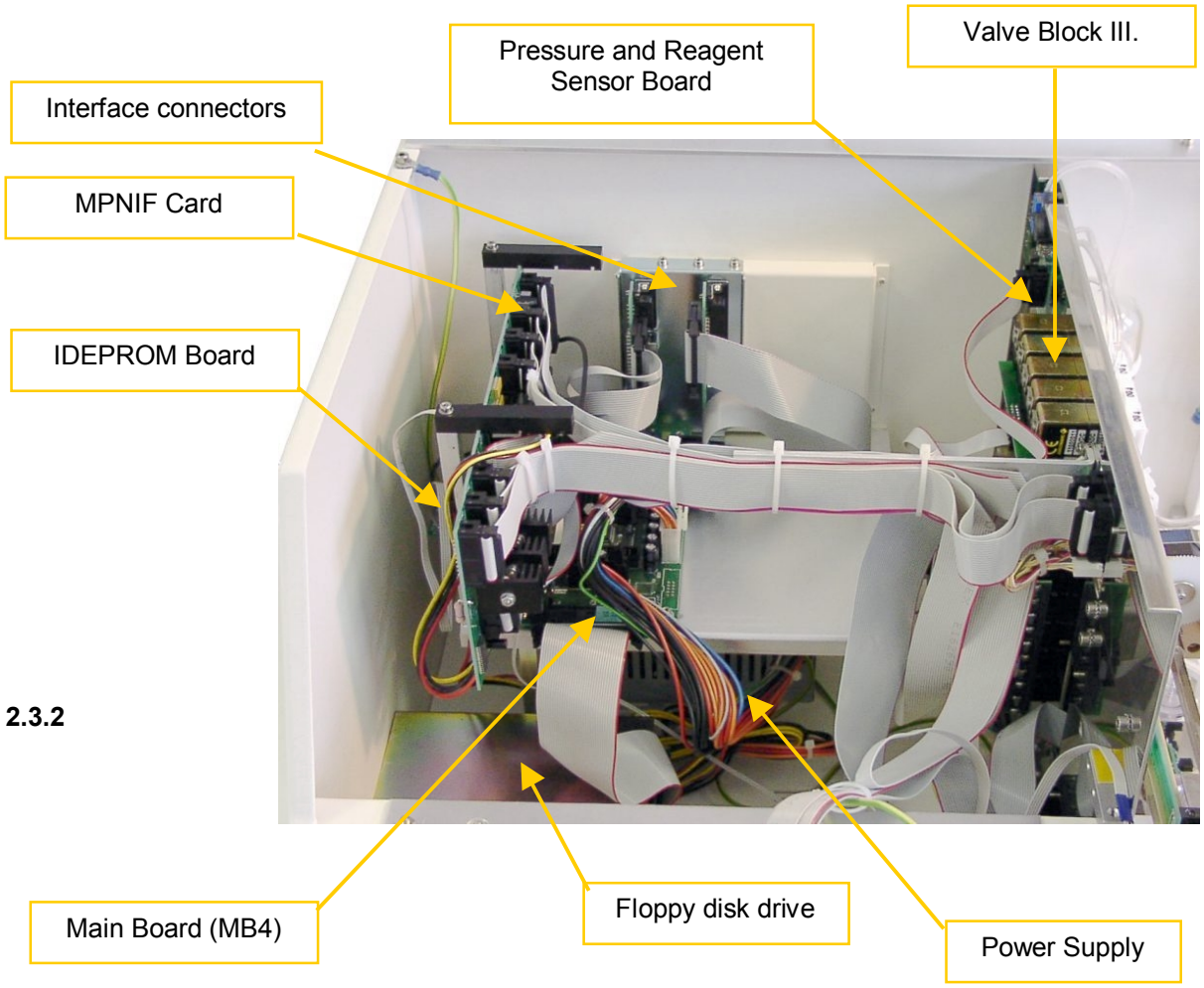
2.3 Assembled Analyzers

This section includes the photos of the assembled analyzers. There are two main parts for both instruments:

- The electronic block located on the left side
- The mechanic and fluidic block located on the right side and it is assembled to a stainless steal assembly plate, which makes also the separation from the electronic block

2.3.1 HUMACOUNT PLUS Electronic Block

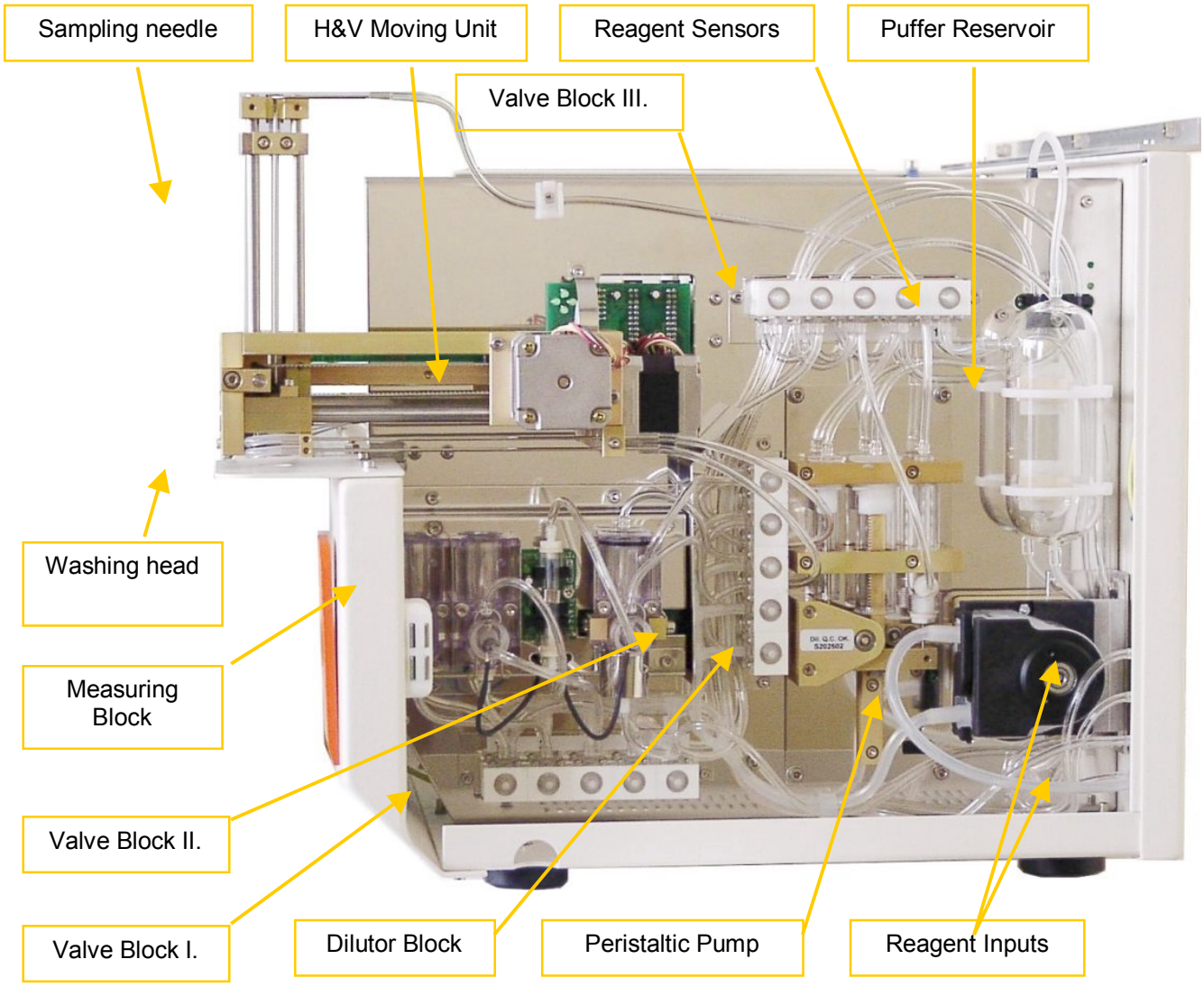
This block contains the main electronic parts of **HUMACOUNT PLUS**, the cables and the main board holder plate.



2.3.2

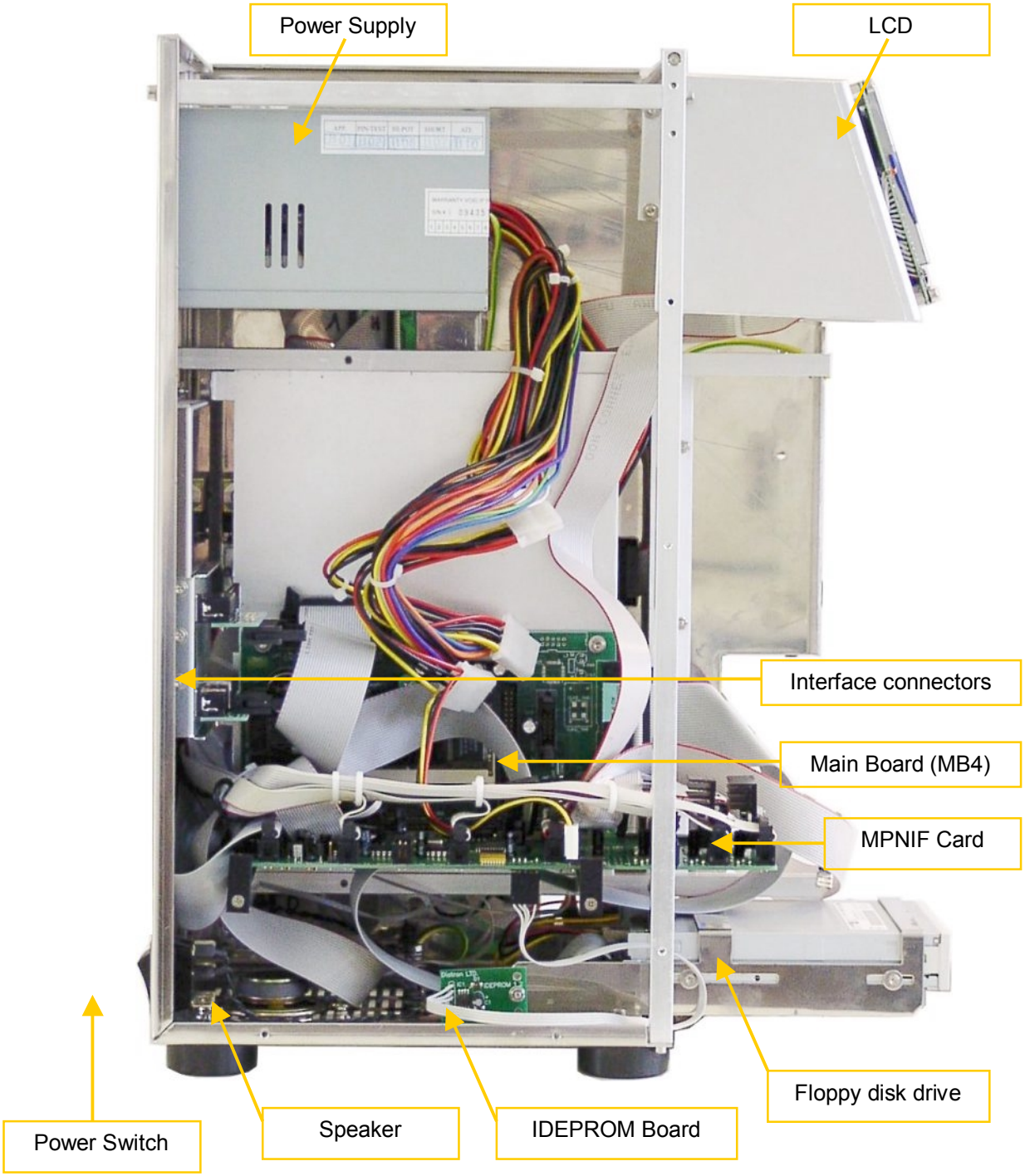
HUMACOUNT PLUS Mechanic and Fluidic Block

This block includes the mechanic and fluidic parts (see 2.2) of **HUMACOUNT PLUS** and it is located on the assembly plate. The analyzer has a door (with magnetic lock) on the right side, which makes easy to access the mechanic and fluidic system.



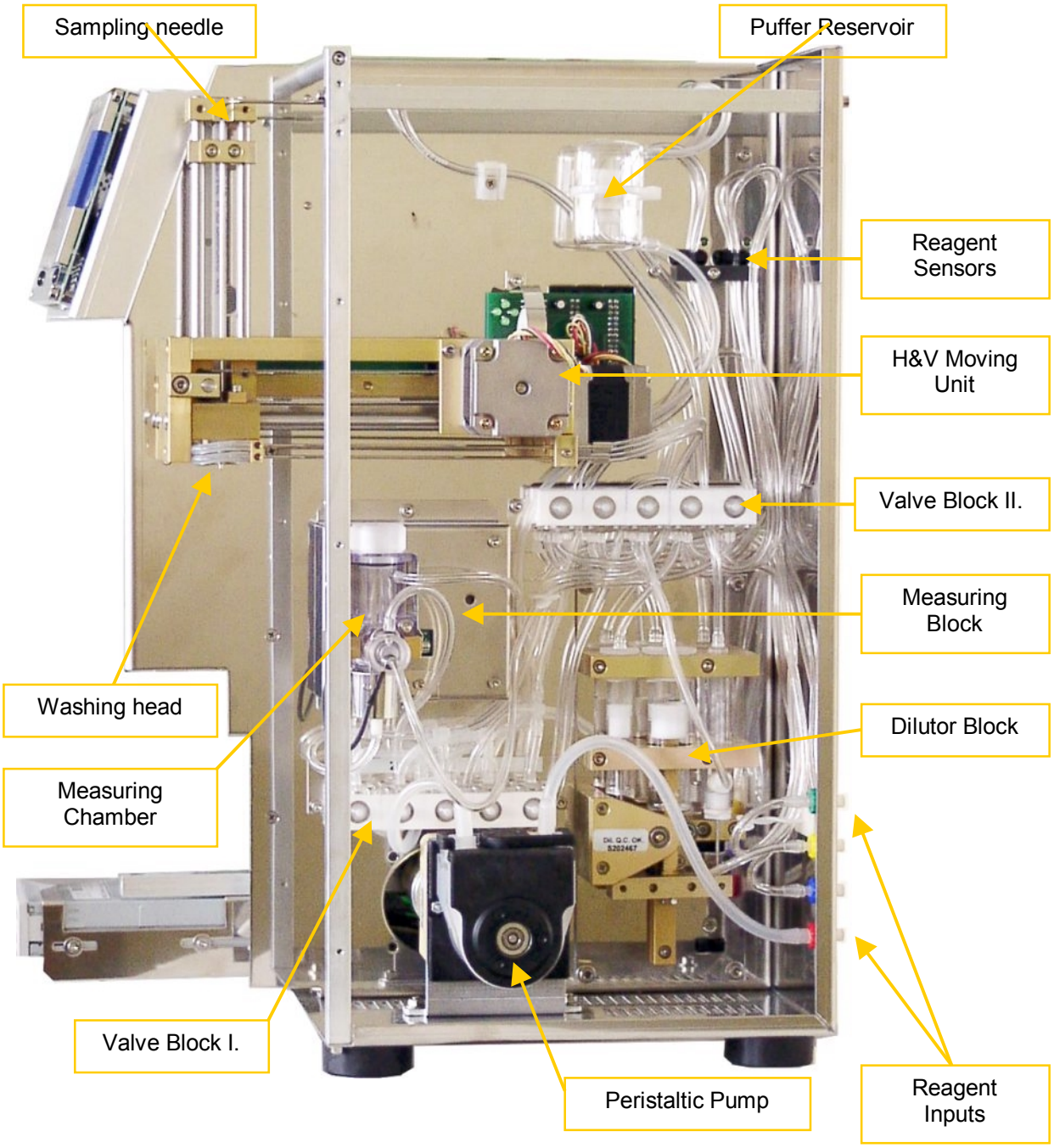
2.3.3 HUMACOUNT Electronic Block

This block contains the main electronic parts of **HUMACOUNT**, the cables, and the main board holder on a rack system plate.



2.3.4 HUMACOUNT Mechanical and Fluidic Block

This block includes the mechanic and fluidic parts (see 2.2) of **HUMACOUNT** and it is located on the assembly plate. The analyzer has a door (with magnetic lock) on the right side, which makes easy to access the mechanic and fluidic system.



3 OPERATION OF THE FLUIDIC SYSTEM

This section describes the main fluidic steps of **HUMACOUNT PLUS** and **HUMACOUNT** measurement cycle. The fluidic systems are totally different in the two instruments but they use the same modules (valves, tubes, chambers, dilutor, etc.) and from the point of the measurements they follow the same steps. For this reason we show the fluidic system processes for both instruments in the same logical blocks.
HUMACOUNT PLUS and **HUMACOUNT** Fluidic Schematics are shown in Section 2.2 of this manual. The following figures show the actual process and help to understand how the fluidic system works.
The following steps are introduced in this section:

1. Sampling process
2. Aspirating tip washing process
3. Diluting process
4. Lysing process
5. WBC counting process
6. RBC counting process
7. Washing processes
8. Cleaning process

The active pipe is filled with black color, beside the tube an arrow (→) shows the direction of the flow. The moving mechanic parts have a bigger arrow (⇧) indicating the direction of movement. Only the open (On) valves are mentioned in this section while all the other valves are closed (Off).

3.1 Waste Full Checking

There is a special pneumatic process in **HUMACOUNT PLUS**, it is called **Waste Full Checking.**

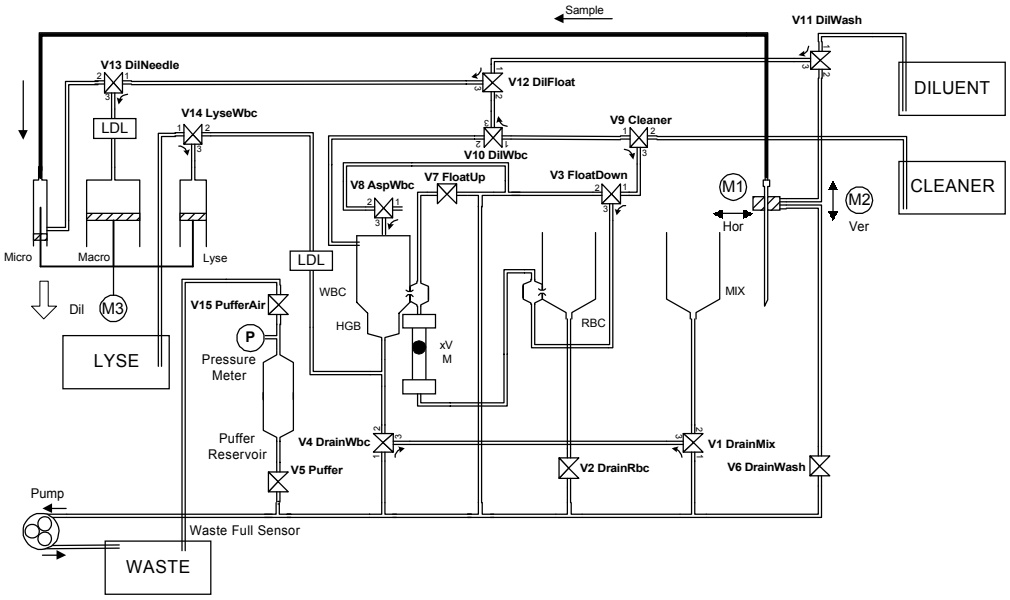
Valve15 switches the measuring vacuum to the waste full sensor tube for a short period of time (10 msec). The pressure meter measures the decrease of the vacuum during this time. From this value the program can decide that the vacuum has aspirated fluid or air so the waste container is full or not.

In **HUMACOUNT** there is no pneumatic Waste Full Checking. It is counting the volume of the reagents used, and gives a message when this volume reaches the preset tank capacity. You can modify the volume of waste tank in the Service menu.
Generally it is recommended to set the volume of waste tank 2 liters less than the real capacity of the tank.

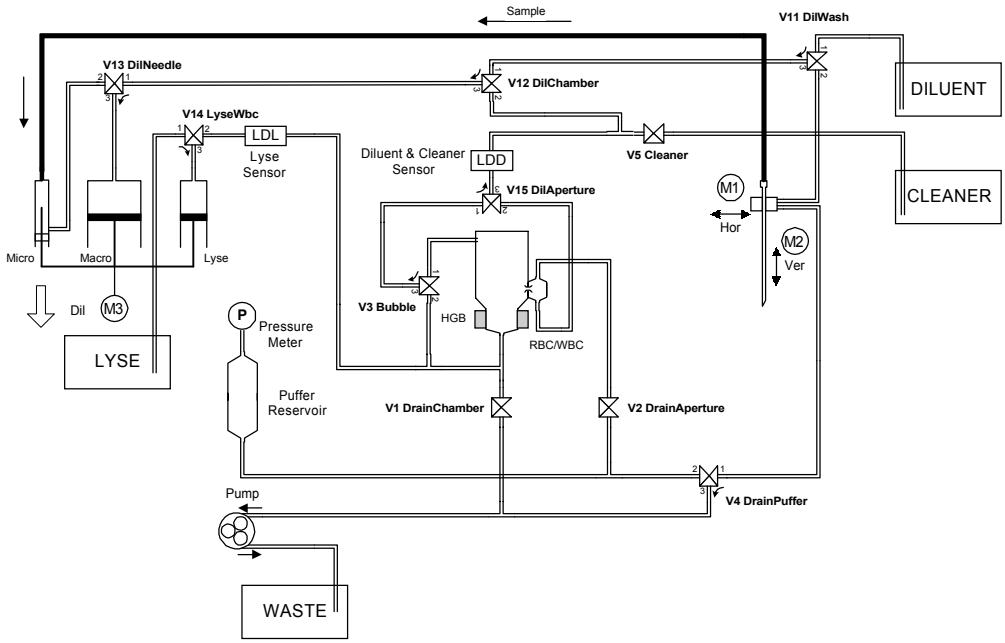
3.2 Sampling process

25 µl (50 µl in pre-diluted mode) of blood sample is aspirated by the aspirating tip. The Micro syringe makes the aspirating while the M3 Dilutor motor moves down.

- In **HUMACOUNT PLUS** there is another sampling process when 25 µl of primary dilution is aspirated by the aspirating tip from the MIX chamber to the RBC chamber for the second (RBC) dilution.



- In **HUMACOUNT** there is also another sampling process for the second (RBC) dilution, 25 µl of primary dilution is aspirated by the aspirating tip from the chamber but it is kept in the aspirating tip during the WBC measurement and the cleaning process.

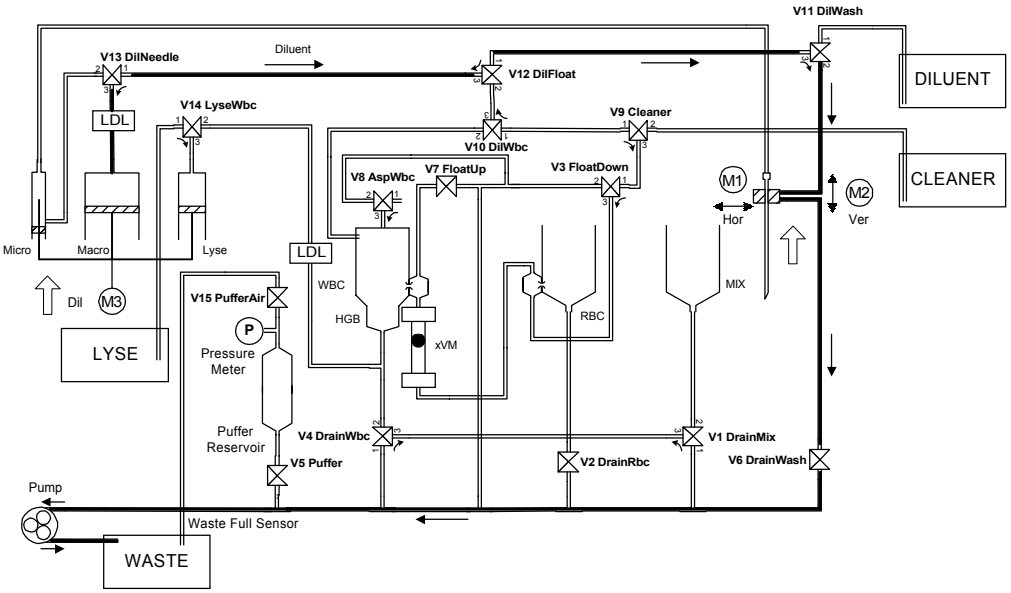


3.3 Aspirating tip washing process

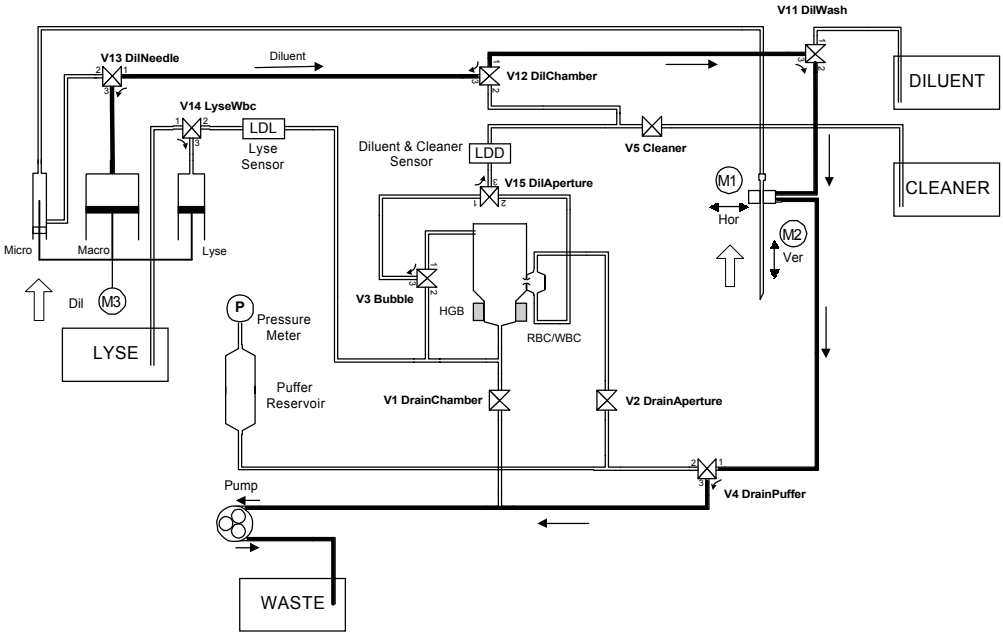
Both instruments clean the aspirating tip with diluent in the washing head after sampling. It is important to clean the outer surface of the aspirating tip to avoid inaccurate sampling.

The Macro syringe doses and the pump drains the diluent from the washing head, while the aspirating tip moves upwards so the total length of it is washed and cleaned. This process is called total aspirating tip washing.
There is another process, which is washing only a part of the aspirating tip, is the same but the tip does not move in the total length, just a part of it. Some procedures perform this kind of aspirating tip washing.

- In **HUMACOUNT PLUS** the Macro syringe doses the diluent through V13 (Off), V12 (Off), V11 (On). The Pump aspirates the diluent from the washing head through V6 (On), while the M2 Vertical motor moves the aspirating tip up.



- In **HUMACOUNT** the Macro syringe pushes the diluent through V13 (Off), V12 (Off), V11 (On). The Pump aspirates the diluent from the washing head through V4 (Off), while the M2 Vertical motor moves the aspirating tip up.

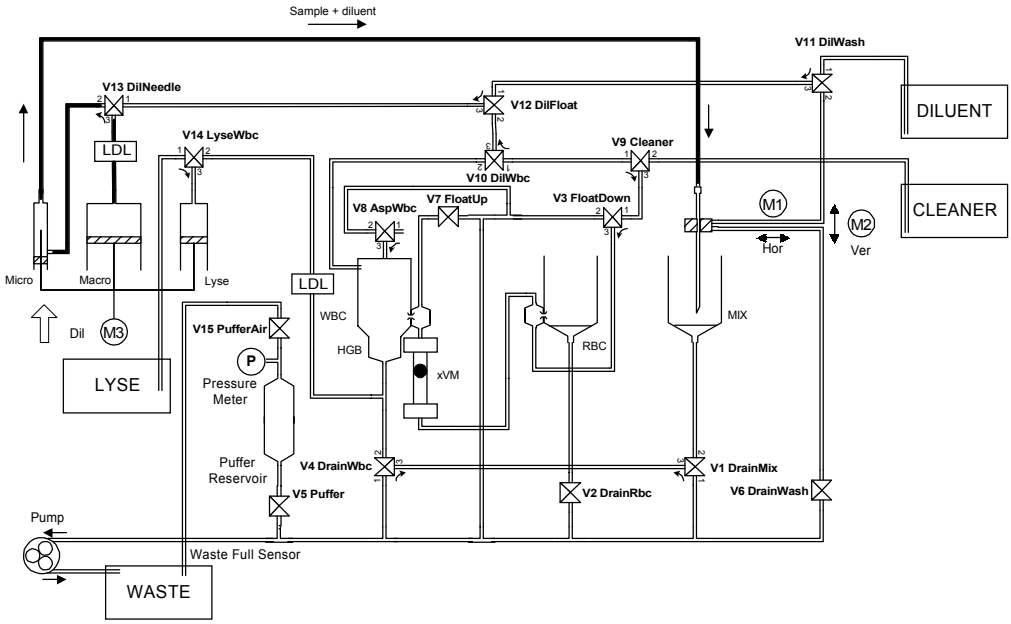


3.4 Diluting process

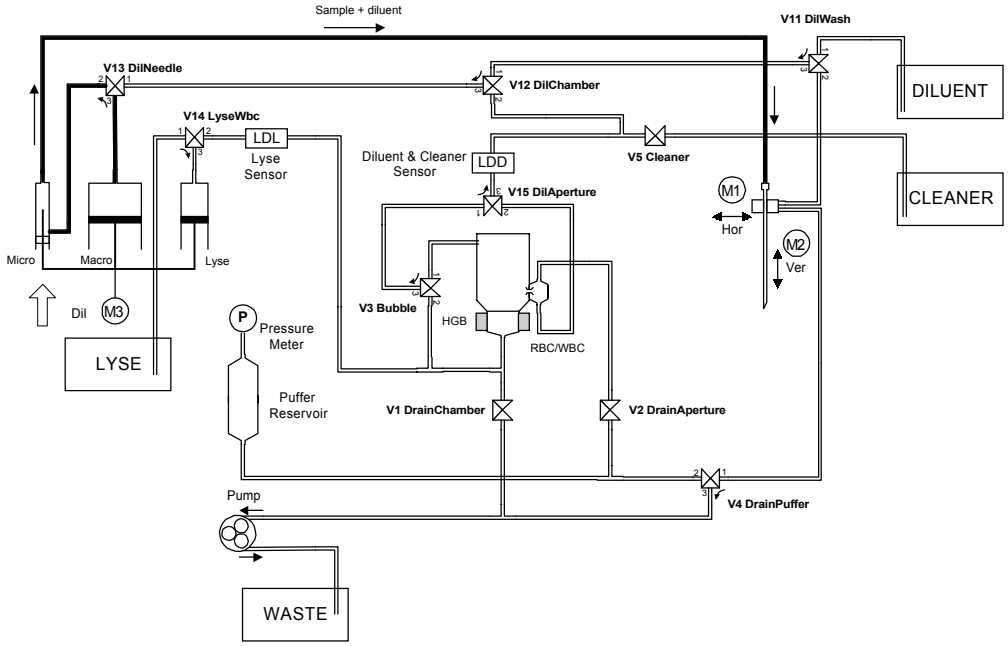
The parts of the fluidics are rinsed with diluent. MIX and RBC chambers in **HUMACOUNT PLUS** and the measuring chamber in **HUMACOUNT** are filled up with 1 ml of diluent. This method prevents the chamber(s) from dirt and makes the diluting process faster.

The sampling process has aspirated 25 µl of sample, which is in the aspirating tip. In the first diluting step the sample is dispensed into the MIX chamber in **HUMACOUNT PLUS** and into the measuring chamber in **HUMACOUNT** with 3.0 ml of diluent, which comes from the Macro syringe through V13 (On) and Micro syringe, while the M3 Dilutor motor moves upwards. This process makes the 1:160 first dilution in the chamber.

- In **HUMACOUNT PLUS** the second sampling process aspirates 25 µl of primary dilution and then it is added with 5.0 ml of diluent into the RBC chamber. This process makes the 1:32,000 dilution in the RBC chamber.

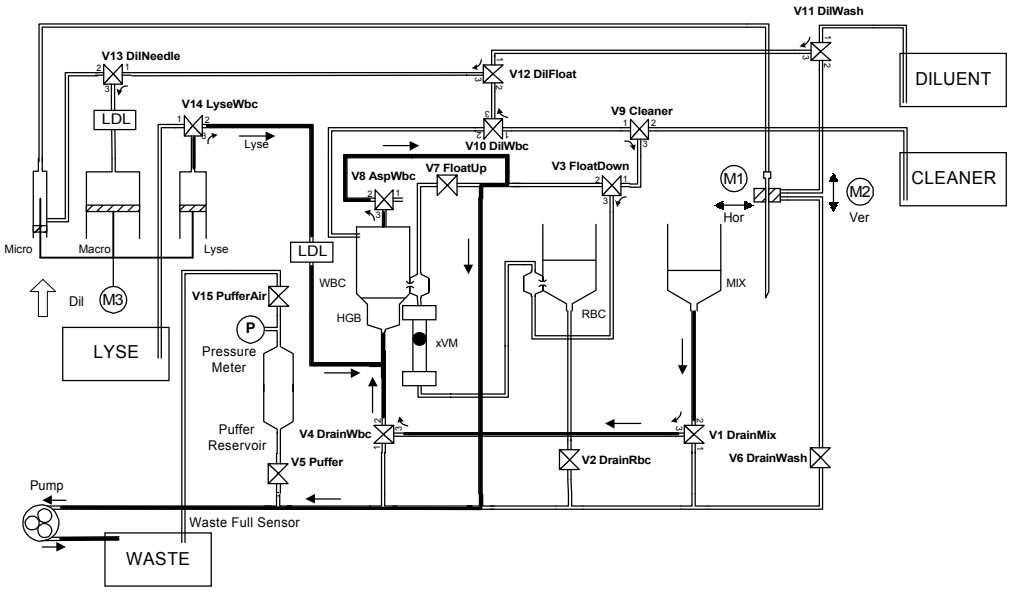


- In **HUMACOUNT** the same dilution rates are made but the second sampling, the 25 µl of primary dilution is stored in the aspirating tip during the WBC measurement and the cleaning process and the instrument makes the second dilution into the chamber after these processes.

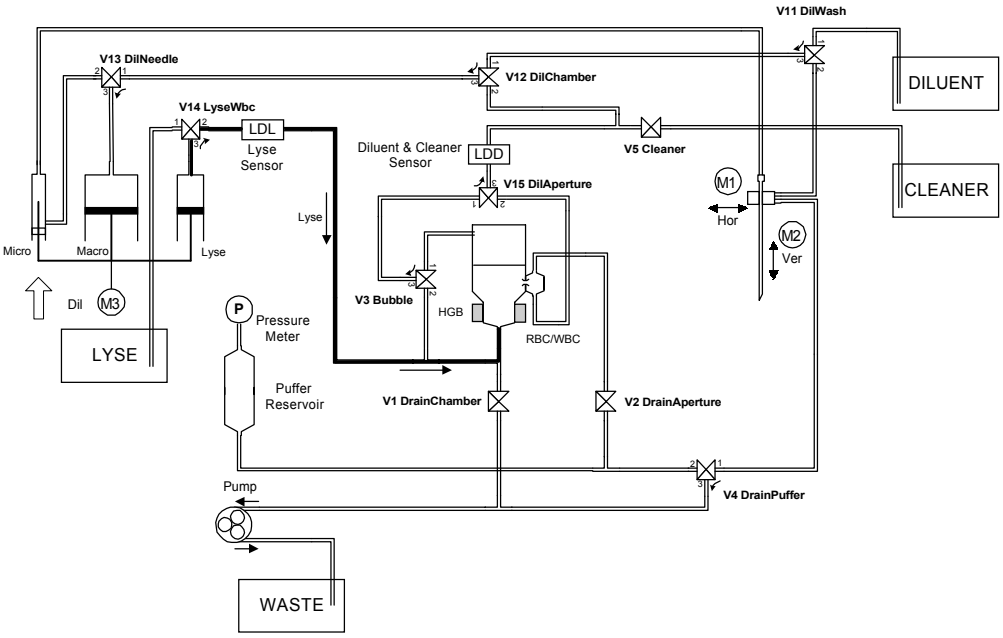


3.5 Lysing process

- In **HUMACOUNT PLUS**, during this step the primary dilution remaining in the mixing chamber flows via V1 (On) and V4 (On) into the WBC chamber), because the vacuum – which is generated by the pump – aspirates the fluid through V8 (On), while V3 and V7 are Off. Simultaneously, 0.7 ml of lysing reagent is added through V14 (On), while the Lyse syringe moves upwards. This process makes the 1:190 dilution rate and good mixing with lyse, and at the end the mixing chamber is empty, and the specified RBC and WBC dilutions are in the proper chambers. After this step the system makes a MIX chamber washing cycle.

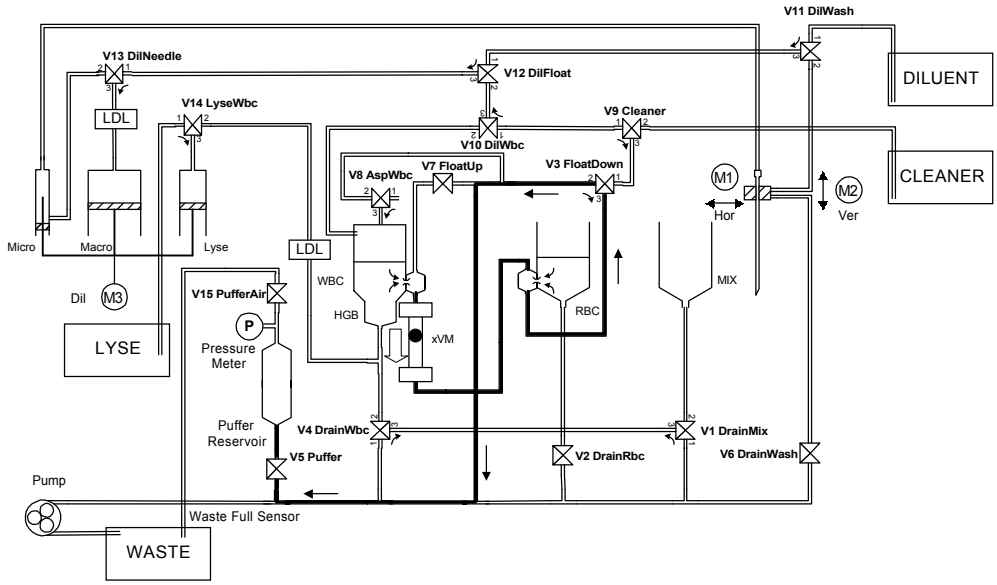


- In **HUMACOUNT**, in this step 0.7 ml of lysing reagent is added into the measuring chamber through V14 (On), while the Lyse syringe moves upwards. This process makes the 1:190 (WBC) dilution rate and good mixing with lyse (the syringe also pushes some air bubbles for mixing).



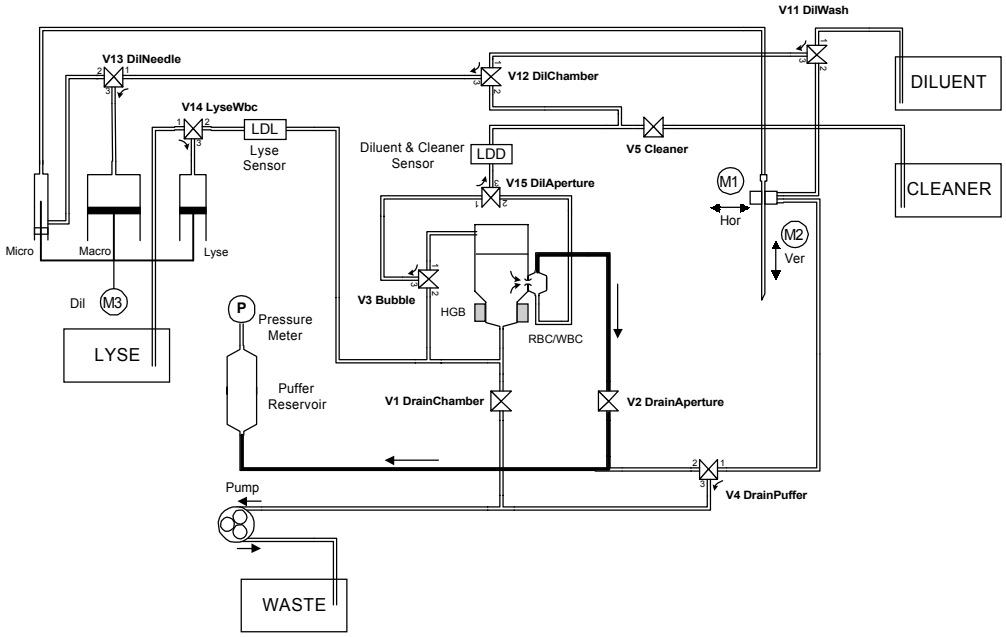
3.6 WBC counting process

- In **HUMACOUNT PLUS** at the beginning of the WBC counting process the analyzer moves the float up by diluent reagent coming from the macro syringe. V12 & V7 are On, V10, V9 and V3 are OFF, and pump drains the reagent. By this time the pump has generated the regulated vacuum in the puffer reservoir.
  After that, the vacuum aspirates the diluted sample from the WBC and RBC chambers through V3 (ON) and V5 (ON) valves while all others are OFF (during this the pump is OFF which is equivalent to a closed valve). Both WBC and RBC samples are flowing through the aperture but the float measures only the WBC sample volume by moving down until the lower opto switch is off. When the float reaches the lower opto, V3 is closed. In this state the HGB measurement is executed.



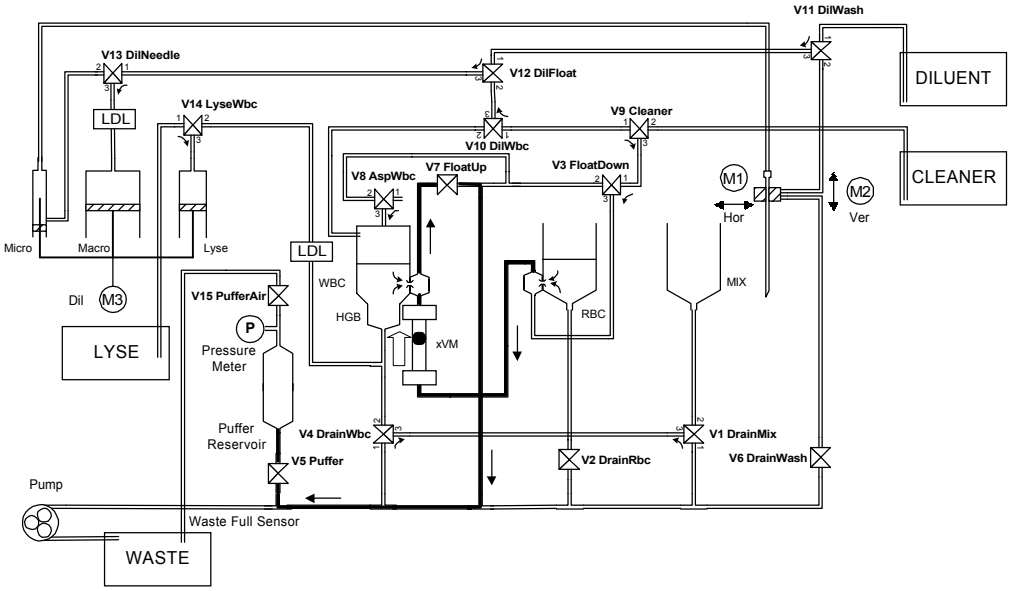
- In **HUMACOUNT** the regulated vacuum (it is generated by the pump in the puffer reservoir) aspirates the diluted sample (WBC) from the chamber through V2 (On) valve. There is no volume limiter, so the instrument counts the cells for 8 seconds.

  At the end of this process the HGB measurement is executed.



3.7 RBC counting process

- In **HUMACOUNT PLUS** the RBC counting process is executed immediately after the WBC counting process when the float is at the lower opto sensors. The measuring vacuum (which is in the puffer reservoir) aspirates the RBC sample through V7 (ON) and V5 (ON) valves while the V3 valve is OFF. Both, the WBC and the RBC samples are flowing but the float measures only the RBC sample volume by moving upwards. With this method a predefined sample volume (200 µl) is measured, but he WBC and the RBC measuring times are different because the diameter of the cell-counter apertures are different.



- In **HUMACOUNT** the RBC counting process is absolutely the same as the WBC from the pneumatical point, but the diluted sample – which is aspirated by the regulated vacuum from the chamber – is the second dilution rate made by the second dilution process. RBC counting time is also 8 seconds.

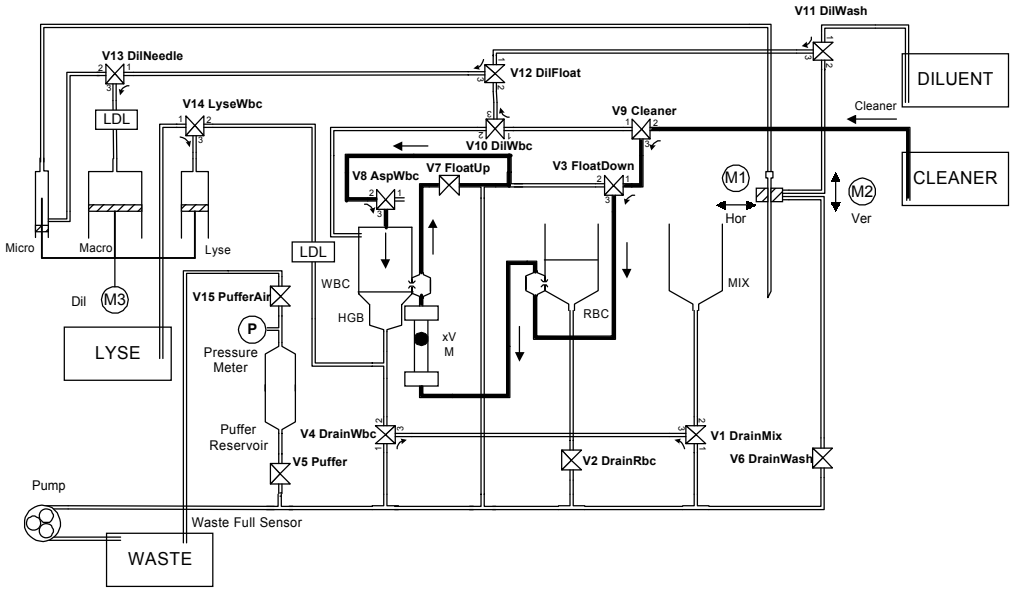
3.8 Washing processes

Both instruments make the necessary washing processes such as MIX, WBC and RBC chambers washing processes in **HUMACOUNT PLUS**, and chamber washing process in the **HUMACOUNT**.
The systems has a two-step washing method, which ensures a very low carry over between measurements. At the first step – called pre-washing – 1 ml of diluent washes the actual chamber and the pump drains it. At the next step – called main washing – the actual chamber is primed with diluent. This diluent volume is higher (+ 0,2 ml) than the chamber's operating sample volume.
Sometimes (for example the MIX washing in **HUMACOUNT PLUS**) this second diluent is not drained immediately after the washing process, it stays in the chamber protecting it from contamination. In this case the chamber is drained at the end of the total washing process.
Draining is a very simple fluidic method. The Pump aspirates the fluid from the actual chamber or tube through its draining valve is On while the other valves are Off.
In **HUMACOUNT** the washing process also use Cleaner solution to clean the chamber from the lyse reagent between the WBC and RBC measurements and after each measurement cycle.
High-voltage burning pulses are applied to the apertures in each measurement cycle to prevent lipid and protein build-up.

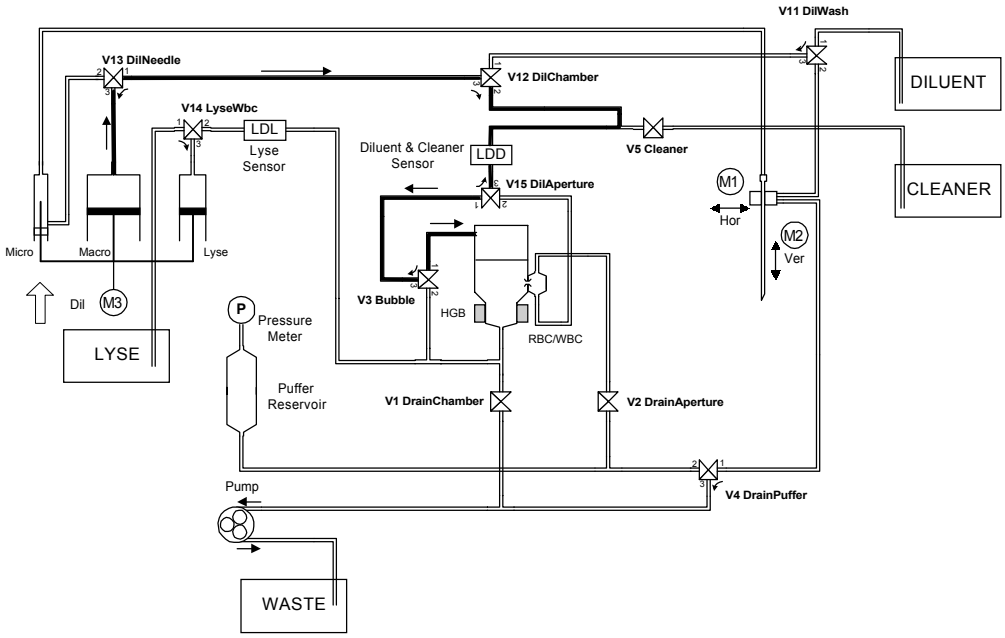
3.9 Cleaning process

- In **HUMACOUNT PLUS** the system can clean the apertures and the volume limiter with the connected cleaner reagent. The pump aspirates the cleaner through the V7 (On), V3 (Off) and V9 (On) valves.

  After that the instrument cleans the WBC chamber with cleaner reagent (Section 6.4).
  The instrument generates vacuum in the WBC chamber (with the pump), and after that this vacuum aspirates the cleaner reagent into the WBC chamber through V9 (On), V3 (Off), V7 (On), V8 (On). This second process is called **Autoclean** (see the figure), which is a part of the normal cleaning cycle.



- In **HUMACOUNT** the pump aspirates the cleaner through the V5 (On), V15 (On), V2 (On) and V4 (On) valves to clean the aperture. After that the instrument cleans the chamber with cleaner reagent that remained in the tubes between V12, V5 and the liquid detector (Dil. And Cleaner detector): the Macro syringe doses diluent and cleaner reagents (from the tubes) through V13 (Off), V12 (On), V15 (Off) and V3 (On) into the chamber.



4 ADJUSTMENT

There are some very important mechanical and hardware settings in both (**HUMACOUNT PLUS** and **HUMACOUNT**) systems and there are some software settings, which are available only for Service Personnel. The mechanical and hardware adjustments are described in this section. Special software settings are included in the 5.2 section of this Service Manual.

4.1 Mechanical settings

There are two very important and necessary mechanical settings in both instruments:

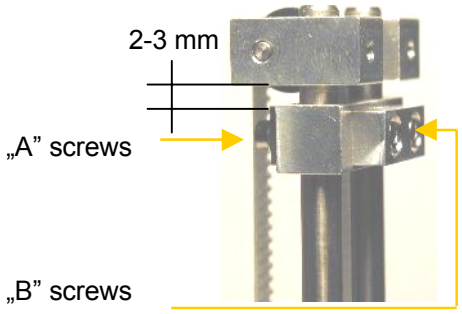
- **Opto wheel setting**
- **Aspirating tip setting**

All analyzers are adjusted by the manufacturer before shipment, but there is a possibility to change any part of the mechanical system and in this case the Service Personnel must do these important settings. The omission of these settings can cause malfunction or damags to the instrument.

4.1.1 Opto wheel setting

This setting may be necessary for the vertical motor movements because this adjustment sets the opto detectors of the H&V moving unit. The top of this block is called HV head and it is shown in the figure below.

– Set the distance to **2-3 mm** between the two parts of the head.

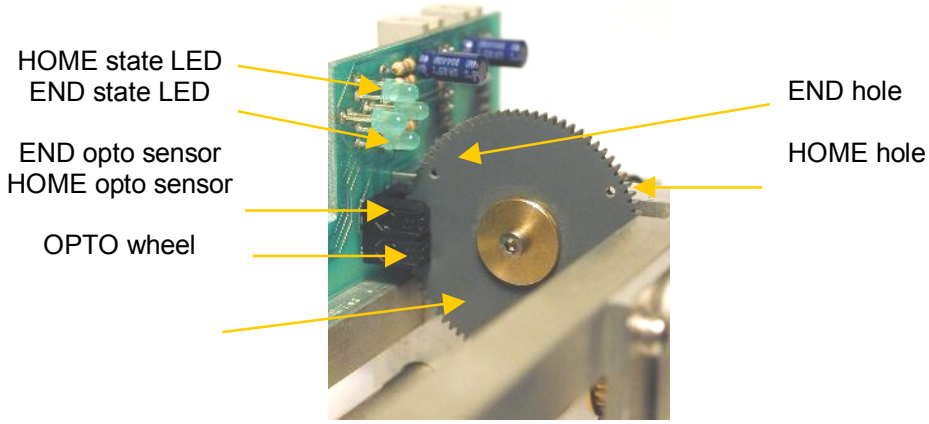


– Loose the „A" screw for free movement on the timing belt.

– Adjust the opto wheel to the home position while the head stays untouched. Fix the „A" screws.

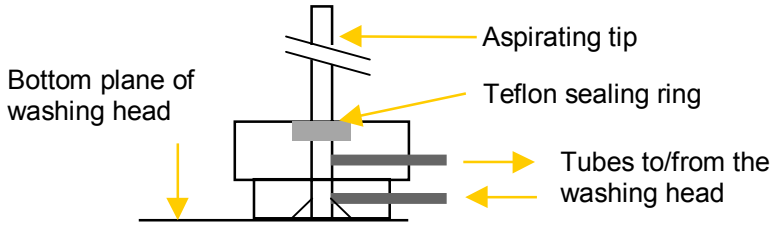
Home position is reached when the HOME hole is in the HOME opto sensor, and the HOME state LED goes OFF on the H&V motor opto board (see picture below).

After that check the END position, as well: move the needle to the lowest position (it is indicated by END state LED). In that state **1-2 mm** distance must be between the carriage and the bottom of the H&V moving unit.



4.1.2 Aspirating tip setting

This adjustment sets the aspirating tip to the operational position. Set the distance between the two parts of the HV head to 5 mm. Loose the „B" screws and adjust the aspirating tip to its operational position.



Washing head is located in the bottom of the H&V moving unit, which is shown in the figure above. Use the Needle setting menu point in Service/Miscellaneous menu. The instrument will move the motors to setting position, and hold the carriage, so that adjustment can be made safely, without unintentional moving of the carriage.

Set the point of the tip to the washing head's bottom plane, while the carriage is held by motors. (Needle setting menu). Fix the „B" screws.

After setting, exit from the Needle setting menu and check the position of the tip and if it is necessary make the adjustment again.

4.2 Hardware settings

The most part of the hardware settings are adjusted by the manufacturer and it is not required to reset these settings. There is only one part in both instruments, which claims some adjustment; this is the sensitivity of the liquid detectors.

4.2.1 Adjustment of the liquid detector sensitivity

Liquid/reagent detector sensitivity may be necessary to be adjusted.
Follow the procedure below to find the optimal setting:

1. Without any reagents in the sensor tube, set the Diluent/Cleaner and Lyse potentiometers in the PCPRO board to reach the state, when the LED goes off.
2. After that turn the potentiometers counterclockwise to reach the on state (the LED is on) and after that turn 180° more in the same direction.
3. Check that LEDs go off, when priming with reagents.

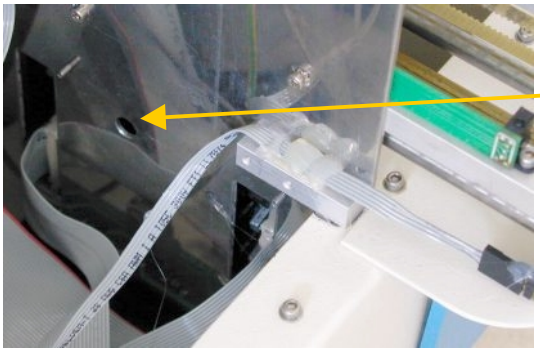
To check the proper operation of the liquid detectors, use the indicator LEDs:

No reagent	LED is on
Reagent, with bubbles	LED sometimes turns on
Reagent, without bubbles	LED is off

4.2.2 Amplifier offset setting

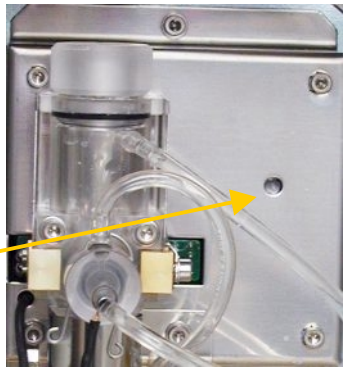
Amplifier offset should be between ±5mV. Run self test to determine whether offset is within this range. If it is out of range, it should be re-set, by the following way.

- In Maintenance/Service/Password/Miscellaneous menu press Offset adjustment menu.
- Adjust the potentiometer to reach 0 mV.



Offset adjustment for **HUMACOUNT PLUS** is not so easy, the potentiometer can be reached from the internal space only.

HUMACOUNT offers easier access for the amplifier offset setting element. It is located on the measuring block.



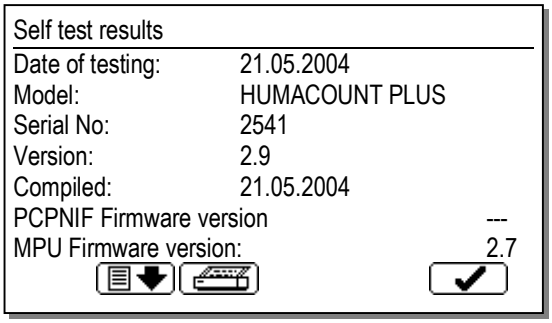
5 CHECKING OF PROPER OPERATION

Both analyzers have built-in Self test and Service menu.

5.1 Self test

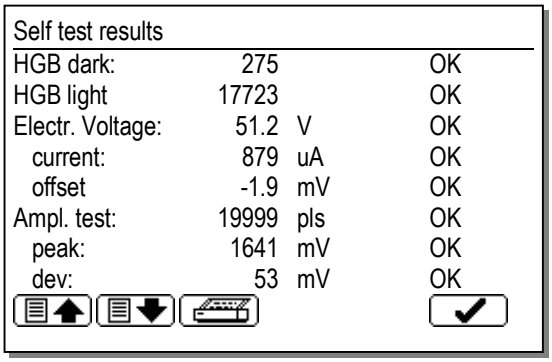
5.1.1 Self Test Screens

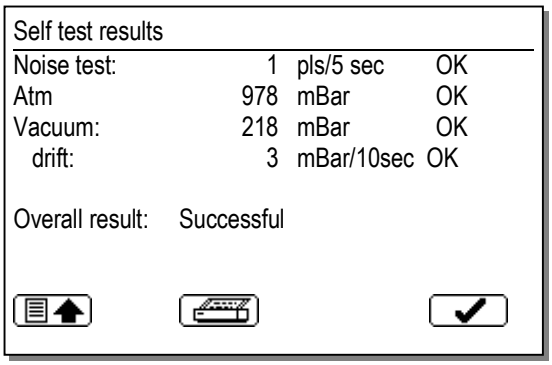
Self test can be used to check the operation of the instrument.



The first panel shows general information about the instrument. (See menu on the left.)

The PCPNIF firmware version will always be empty "- - -", the MPU firmware version holds the MPNIF version number.


Self test results
HGB dark: 275 OK
HGB light 17723 OK
Electr. Voltage: 51.2 V OK
current: 879 uA OK
offset -1.9 mV OK
Ampl. test: 19999 pls OK
peak: 1641 mV OK
dev: 53 mV OK


Self test results
Noise test: 1 pls/5 sec OK
Atm 978 mBar OK
Vacuum: 218 mBar OK
drift: 3 mBar/10sec OK
Overall result: Successful

The second and third panel contains tested parameters, as follow:

- **HGB dark** count (HGB LED is off, this parameter is always zero in the **HUMACOUNT**), and **light** (LED is on).
- **Electrode voltage**, measuring **current** and amplifier **offset**.
- **Amplifier** by generating 20000 **test** pulses, including gain related **peak** value, noise related **dev**iation.
- Amplifier **Noise test** during a 5-second period.
- **Atmospheric pressure** stands for outer pressure.
- **Vacuum** reports pump operation (vacuum generated by the pump in a 10-second period of time).
- **Drift** represents pressure loss of vacuum measured in a 10-second period of time.

At the end of each result line a **status message** is displayed, which means that the actual test result is in the normal range (*OK*), higher (*HIGH*), or lower (*LOW*) than the pre-determined limits, or the result produced an error (*ERROR*).

Overall test result is displayed, which can be *Successful* (in case of every test result is *OK*) or *Errors* (if any of the parameters is *HIGH, LOW* or *ERROR*).

5.1.2 Normal range of Self test parameters

Parameter	Unit	Lower bound	Upper bound
HGB dark	count	0	3000
HGB light	count	3000	50000
Electrode voltage	V	45	55
current	µA	830	930
offset	MV	-5.0	5.0
Amplifier test	count	19990	20050
peak of pulses	MV	1300	1700
deviation (noise)	MV	0	100
Noise test	pls/5sec	0	50
Outer pressure	mBar	600	1100
Vacuum	mBar	125	250
Drift	mBar/10sec	0	10

5.1.3 Troubleshooting Guide for Self test

Parameter	Mark	Possible reason	Remedy
HGB dark	*HIGH*	Instrument door open	Close instrument door
HGB light	*LOW*	HGB head not connected or HGB LED out of order	Check HGB head connections or check HGB LED operation during measurement
	HIGH	Instrument door open or HGB LED too bright	Close door or replace HGB head
Electrode voltage	*LOW* or *HIGH*	Fault on High Voltage or Amplifier board	Check measuring voltage (50V) on High voltage and Amplifier boards
Current	*LOW* or *HIGH*	Fault on Amplifier board	Check current generator, relays and test generator FET on Amplifier board
Offset	*LOW* or *HIGH*	Unadjusted Offset on Amplifier board	Adjust the offset potentiometer on Amplifier board
Amplifier test	*LOW*	MPNIF and Amplifier Boards are not connected	Check cables and connectors between MPNIF and Amplifier
	HIGH	Instrument not grounded	Check mains ground lead
Peak of pulses	*LOW* or *HIGH*	Fault on Amplifier board	Check current generator, relays and test generator FET on Amplifier board
Dev. (noise)	*HIGH*	Instrument not grounded	Check mains ground lead
Noise	*HIGH*	Instrument not grounded	Check mains ground lead
Outer pressure	*LOW* or *HIGH*	Pressure sensor, cable, amplifier or PIC#0 error	Check pressure sensor on PRO board, cable connections and MPNIF board pressure amplifier
Vacuum	*LOW*	Peristaltic pump failure	Check peristaltic pump & tube
Drift	*HIGH*	Leakage in pneumatics	Check tubing in pneumatics

5.2 Service Menu

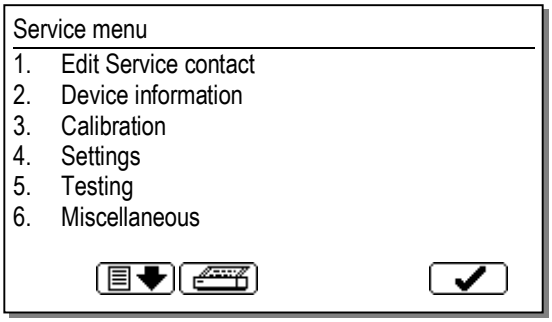
5.2.1 Entering to Service Menu

There is a Service menu for servicing and operation checking purposes. The entry point is in the Maintenance/Service screen, where Service Information is displayed.

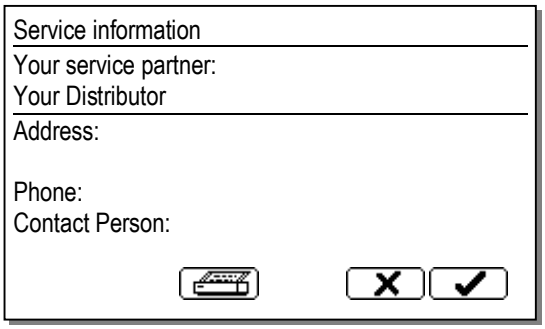
Enter the code to access Service menu: 6484

5.2.2 Main Service Menu

The Main Service menu provides access to submenus and service utilities.



5.2.3 Edit Service Contact

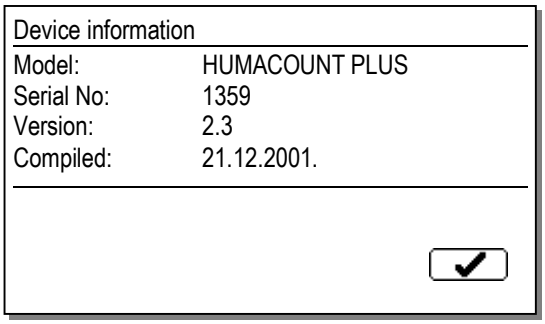


The information set up here is shown in the Maintenance/Service screen for the user.

You can edit the Information fields by cursor keys, or by an external keyboard.

Press the OK button, if a field is completed.

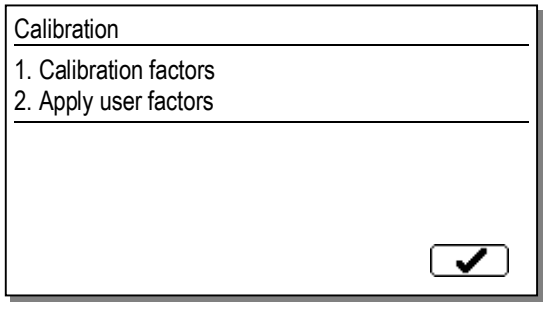
5.2.4 Device Information



In the Device Information menu the model name, the serial number, the software version and compilation date appear.

5.2.5 Service Calibration

Calibration menu is provided for Service calibration purposes.



In result calculations the service calibration factors are used as the user calibration factors, so they are multiplied for each parameter:

$$RBC_{Disp.} = Fact_{RBC\ User} * Fact_{RBC\ Serv.} * RBC_{Measured}$$

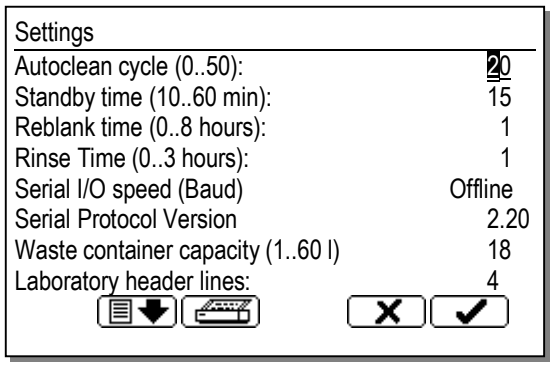
If the user factor is near the bound (0.80 – 1.20), by setting the corresponding service factor, the user factor can be adjusted to 1.00.

$Fact_{RBC\ User}$ = 1.19 and **$Fact_{RBC\ Serv}$** = 1.00, **and** **$Fact_{RBC\ User}$** = 1.00 and **$Fact_{RBC\ Serv}$** = 1.19 gives the same result for RBC.

Apply user factors function can be used to move the combination of the existing user and service factors, automatically to the Service level. If all service calibration factors were 1.00, after this function all service factors will be set to the product of the previous user and service factors, and all user factors will become 1.00.

5.2.6 Software Settings

Software settings can be customized in this menu.


Settings
Autoclean cycle (0..50): 20
Standby time (10..60 min): 15
Reblank time (0..8 hours): 1
Rinse Time (0..3 hours): 1
Serial I/O speed (Baud) Offline
Serial Protocol Version 2.20
Waste container capacity (1..60 l) 18
Laboratory header lines: 4

Autoclean cycle (HUMACOUNT PLUS only): after how many measuring cycles HUMACOUNT PLUS makes an autoclean process (default = 20 cycles). Zero means **never**!

Lower this setting if periodic noise appears in the system, i.e. 12-15 measurements good, and after that 5-8 measurements with high PLT.

Stanby time: after how many minutes the instrument goes to standby mode. This is the setting used in Measure mode, if Start has not been pressed, chambers will be primed to avoid clogging of aperture (default = 15).

Reblank time: after how many hours the instrument makes a blank measurement if it was in stanby mode (default = 1 hour). If it is set to 0, then no ReBlank is performed.

Rinse time: If this time is set, then the instrument will make an automatic, extended washing procedure (with more diluent) of the chamber(s) to get wash dirt out of the chambers (dust). If it is set to 0, then no Rinse is performed.

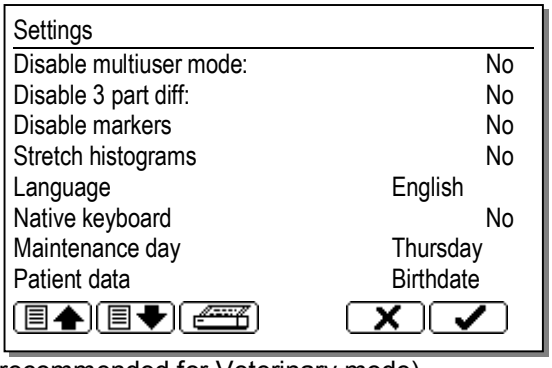
Serial I/O speed: instrument can send results to a host computer via serial port with the RS232 V24 protocol. The baud rate of this serial communication must be selected at this point. For details of the serial communication protocol, see Appendix 9.2 in this manual.

This setting must be set to the desired baud rate, otherwise the link to PC is not possible.

Serial Protocol Version: with this option, the used protocol (sending specific fields or not) can be selected. This is useful when a new software (with more stored e.g. patient info) is installed in laboratory system, where an earlier serial protocol has been implemented.

Waste container capacity (HUMACOUNT only): to set the correct volume of the waste container for proper usage of the software ”waste full” alert. Set this value 2litres less than the total volume of waste container.

Laboratory Header Lines: this setting controls the available lines to set up the laboratory header on printed reports. The header text can be edited on user level.



Disable multi-user mode: by this setting the multi-user mode can be disabled on the user level

Disable 3-part diff.: for using quick lyse (without 3-part differential) the errors and the bad 3-part parameters can be excluded from the results

Disable markers: setting this option to Yes will omit the markers from the reports (it is commonly used for Veterinary application)

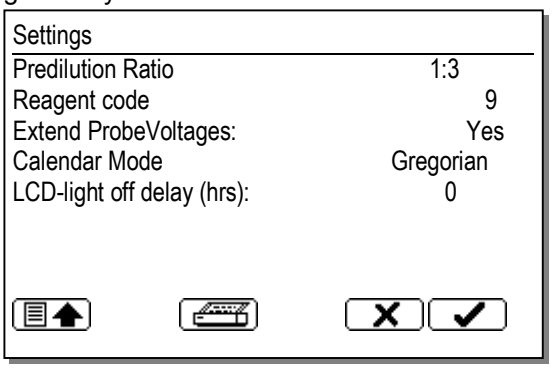
Stretch histogram: setting this option to Yes will modify the WBC histogram from 0-300 fl instead of 0-400 fl (this is recommended for Veterinary mode)

Language: this setting will adjust the user language. The Service menu always in.
Available languages: Arabic, English, French, German, Greek, Hungarian, Indonesian, Italian, Polish, Portuguese, Romanian, Russian, Spanish, Turkish and Vietnamese. Chinese language is available *only for special models.*

Native keyboard: Setting it to Yes will utilize the external PC keyboard with the language specific layout.

Maintenance day: You can select among the days of the week. According to this setting, the instrument will warn the user to do the weekly maintenance when shut down.

Patient data: There are two options: *Birthdate* and *Age*. According to this setting, in the sample information dialog and in the database, the instrument will prompt for the age or the date of birth. If age is specified, it can be given in years or months.



Predilution ratio: can be selected between 1:10 or 1:3. This ratio is used in Pre-dilution mode.

Reagent code: a value to modify the zero point of HGB function, valid between 0-30, (default =9). For pre-diluted sample, HGB can have a significant offset due to reagent non-linearity.

Set code = 0, and measure HGB in pre-diluted mode, and in normal mode. Adjust the code until the 2 HGB results are the same, then calibrate HGB. Use this reagent code with your reagents.

Extend Probe Voltages: This option is ON by default. It makes the instrument accept the physically highest probe voltages: 450 on both channels (it is expressed in A/D resolution, where 1023 shows 55V, so 450 is practically 24.2 V on the electrode).

Probe Voltage – displayed in the measurement results screen are representing the electrical probe potential of the measuring electrode. They are displayed in a range, like

RBC Probe Voltage: RPrV = 223-228,
WBC Probe Voltage: WPrV = 245-249

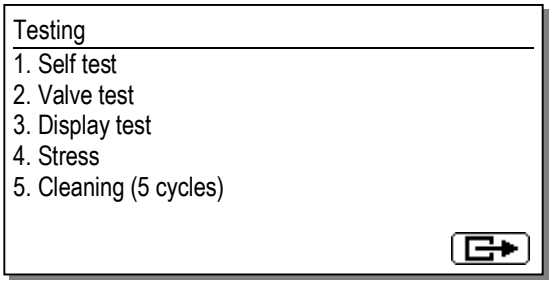
Probe voltage can change a maximum of ± 4%. If it changes more than 4%, or it is higher than 420 (or 450 if Extend Probe Voltages in On), the analyzer will display an error, and 'C' or 'c' flag will show clogging condition on the corresponding channel.

Calendar mode: You can select between the Gregorian and the Jalaali (Persian) calendar. All dates will be converted accordingly.

LCD light off delay: The time that elapses without any user activity to turn off high-voltage You can select between the Gregorian and the Jalaali (Persian) calendar. All dates will be converted accordingly.

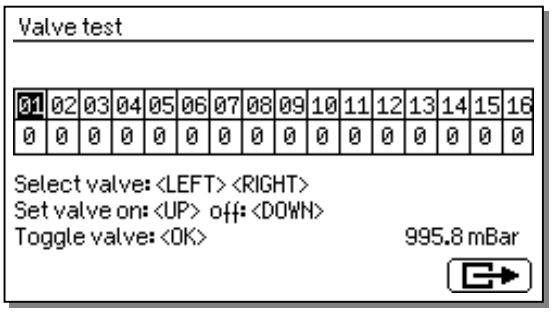
5.2.7 Service Testing Menu

Service Testing menu provides tools for checking operation, fluidics and hardware.



From this submenu **Self test** can be run (see Section 5.1).

5.2.8 Valve Test Menu

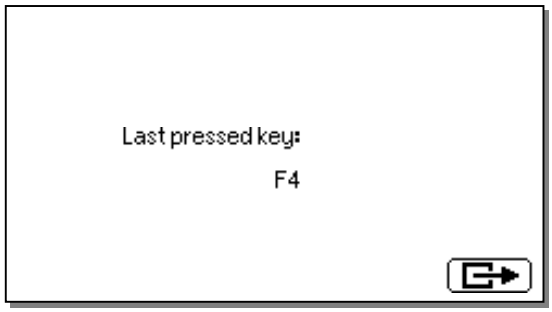


In Valve Test menu valve numbers and their state are displayed. The number under each valve represents the actual state of the valve. Selected valve number is shown in inverse.

0 is **Off** state, 1 is **On** state. **Valve 16 means peristaltic pump**. **HUMACOUNT** has no valves 6-10.

Use cursor keys for selecting and setting valve state, or press OK to toggle state.

5.2.9 Display and Keyboard Test



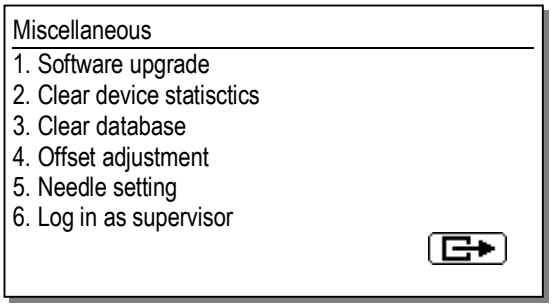
Display and keyboard test is provided to check keypad and LCD panel.
Press a key to test and the LCD will show the code of the pressed key, and will be invert the colors at each touch of a key for testing that every LCD dot is functioning properly.

5.2.10 Stress mode

In **Stress mode,** the instrument performs measuring cycles without sample (blank measurements) continuously. This can be used for burn-in tests, or to check/clean pneumatic system after changing any main fluidic parts.

You can have information about stability, cleanliness, HGB operation, and for HUMACOUNT PLUS the float operation. Results of the last 10 PLT and HGB blank is displayed as well.
You can detect any kind of noise, or bubbles in the system if the PLT is not stable low, or HGB has big variation.
The operation of the volume limiter tube can be monitored by the displayed floating (measuring) time for RBC and WBC measurement, and besides their calculated minimum, maximum and the standard deviation.
To exit from this mode **press START button** (at the end of a normal cycle) until the Stress operation is finished.

5.2.11 Miscellaneous settings



In this menu, you can directly perform **Software upgrade** (this will restart the instrument).

Clear Device Statistics: Device statistics (number of measurements, aperture-clogging and other errors) can be cleared.

Clear Database: The whole Database (measurement results including histograms) can be cleared.

Offset Adjustment: Provides an easy way to set the offset value (see Section 4.2.2).

- Enter this menu to check and/or adjust the offset voltage of the amplifier.
- Adjust the potentiometer to reach 0 mV.

Needle setting: This submenu provides an easy way to set the needle position (see Section 4.1.2).

You can **Log in as supervisor** if the Multi user mode was selected in the User's Settings submenu. (Number 6. - if present, shows the availability of this function.)
In supervisor mode, you have the ability to change any user passwords and you have full access over user settings. **Always log out after this supervisor log in.**

5.2.12 Rescue Code for Multi-user Mode

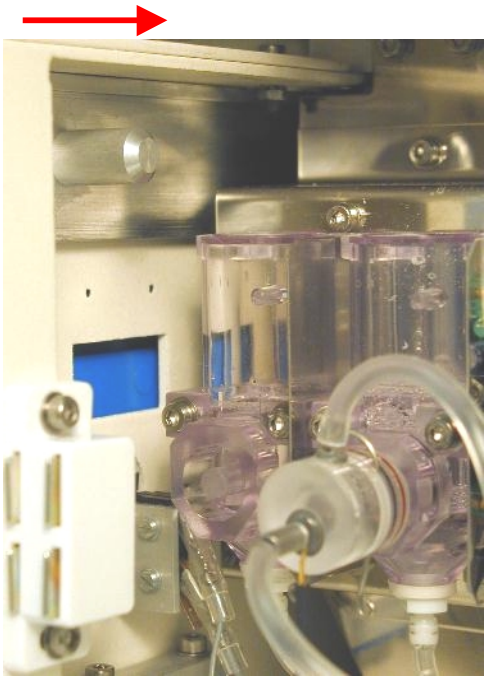
It the supervisor password has been forgotten, there is a rescue code for service purposes to access the supervisor level. Rescue data are:
User ID: **0** (zero),
Name: **Service,**
Password: **729456** (This forms a capital „A" on the keypad)

6 SERVICE OPERATIONS

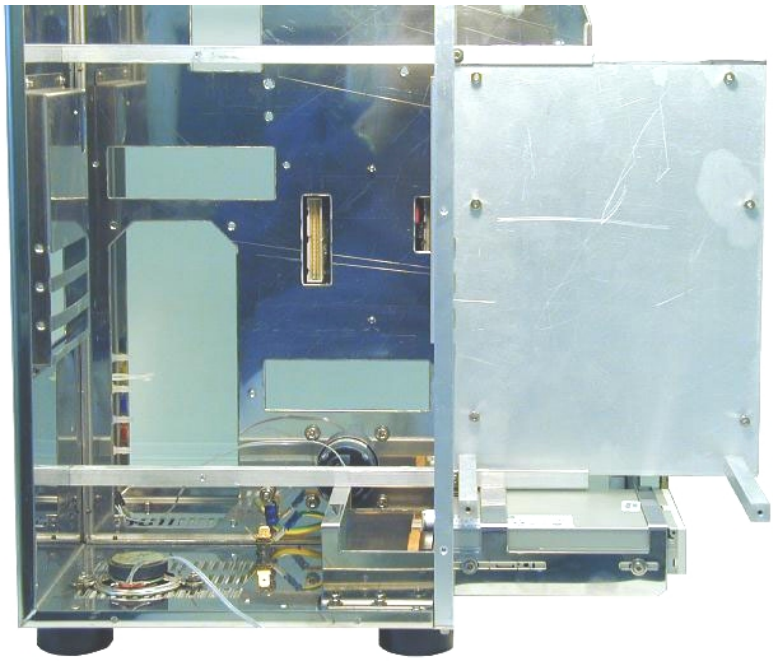
6.1 Opening of the instrument

The left side of both instruments is a side door, which allows to reach the fluidic system easily. Other parts of the analyzers can be serviced by opening the cover.

- **HUMACOUNT PLUS**: first unscrew the 3 cover fixing ("Z") screws located on the rear panel. After this, open the left side door. In the front part of the analyzer there is a special zip-fastener as it is shown in the figure.
  Push this fastener to the direction of the arrow this will unlock the fastener and after that the cover is ready to open. Pull the cover upward to open the instrument.
  To lock the cover, pull the fastener to the opposite direction.



- For **HUMACOUNT** there is no special fastener for the cover: by unscrewing the cover fixing screws on the rear panel the cover is ready to open. But this instrument has a special sliding rack system for the main board holder plate to provide easier access for cables:



By loosening the main board holder plate fixing screws on the rear panel the Service Personnel can pull out the entire main board holder plate with the main board from the front of the instrument and access the back of the assembly plate.

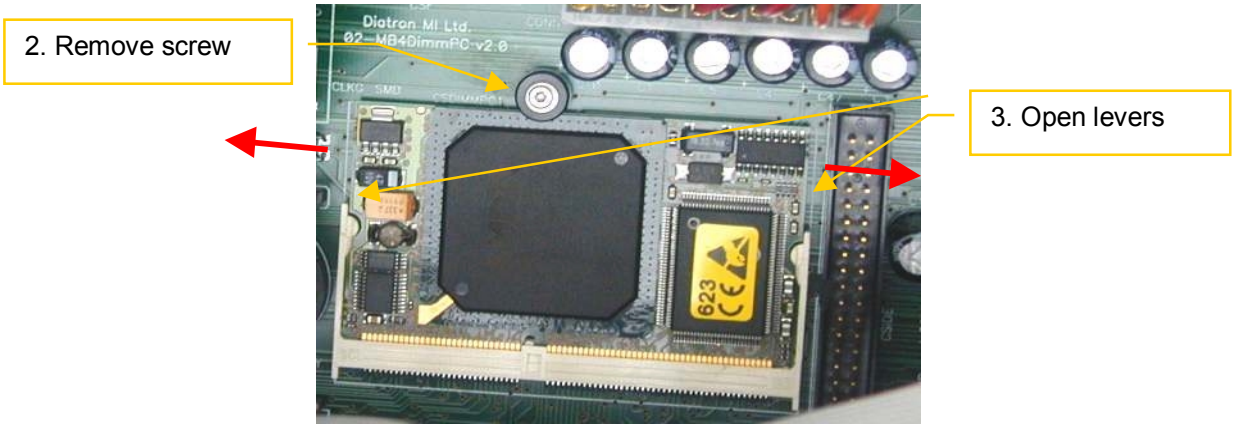
Figure on the left shows a dismounted **HUMACOUNT** for easier understanding.

6.2 Removing/Installing DimmPC

6.2.1 Removing DimmPC

The DIMM-PC can be dismounted in the following way (see Figure below):

1. Discharge all electricity from your body by touching the instrument case before proceeding. DimmPC is very sensitive against electrostatic discharge.
2. Remove the safe lock screw (M2 x 10 mm, hexagonal).
3. Open the two white levers on both sides so that Dimm-PC flips up.
4. Pull out DimmPC module from the socket in a sloping angle.



Dismounting of DimmPC*

6.2.2 Installing DimmPC

1. Discharge all electricity from your body by touching the instrument case before proceeding. DimmPC is very sensitive against electrostatic discharge.
2. Place the DIMM-PC with edge connector to the socket with Heatsink up, at approx. 30° angle and push it softly into the socket. Do not to force it because the socket can be damaged. Pull apart the white holder on both sizes and snap the module into place by pushing it down.
3. Make sure the levers are back in place keeping the module down.
4. Screw in the safe lock screw with the plastic ring (M2 x 10 mm, hexagonal).

**DimmPC is the trade mark of Kontron Embedded Modules GmbH.*

6.3 MDA (Monochrome Display Adapter) emulation mode

MDA emulation mode was developed to provide video output to be displayed on the LCD.
This mode is available during the total operation but especially useful for checking the BIOS setup and OS functions. This mode should be handled the same as the service menu, the user does not have to know these options.
At power-on, the controller PIC on MPNIF card is configuring the FPGA chip and displays the greeting screen. After 6 seconds, it starts to scan the keypad and behaves like an **MDA** adapter to the PC, although the displayed screen is still holding the greeting screen.
If you switch to **MDA emulation mode**, the system boot events can be displayed, and the CMOS SETUP program can be started, if necessary.
If the main program does not start in 90 seconds, the PIC will automatically switch to MDA displaying mode to give information about the reason of hang-up. This can be caused by some CMOS failure, e.g. there is a non-bootable floppy disk in the drive, and boot order is set to start on floppy disk, and the system is waiting for user confirmation: “Remove disk, and press a key”.
If you need to run BIOS setup, an external keyboard must be connected.
Hold the „**?**” button, and press and release the „**.**” button on the foil keypad of the analyzer to activate the **MDA** mode. (Use the “?” like a shift button). The display will use the LCD like a primary computer monitor (80 characters by 25 rows). The LCD is smaller than the standard monitor area therefore just about a quarter of the total screen is displayed at once (40 characters by 16 rows).

- to change the actual quarter displayed, use the cursor keys: ← ↑ → ↓ on the keypad,
- to go where the cursor is (cursor follow operation), press the „**?**" button,
- to go back to the normal graphic displaying mode press „**?" and " .**" again.

Quarter 1 on LCD	Quarter 2 on LCD
Quarter 3 on LCD	Quarter 4 on LCD

Definition of displayed LCD quarters in MDA emulation mode

The MDA screen and the Graphical Application Display are existing in the same time. They use different area of the video RAM located on the MPNIF board.
Displaying is controlled by the configuration PIC on the MPNIF board, and hosted by the FPGA. If there is no display in MDA mode (or garbage characters are displayed), check the following points:

1. MPNIF board for correct connection via the ISA slot
2. DimmPC connector, the CPU is not placed correctly in the socket or there is bad contact
3. Replace the DimmPC

6.4 Key BIOS settings for correct operation

To start the setup utility, keep repeatedly pressing the <F2> key on the external keyboard during startup. The start of the Setup program is indicated by the keyboard status LED's coming on and off, then only NumLock remains on. Additional beeps (when <F2> is pressed) indicate running of the Setup program.

Now, use the **?** and **. (dot)** keys on the instrument keypad to enter MDA mode, to see computer display on LCD. With MDA mode, you get the normal PC screen displayed on the LCD. As the LCD is smaller than the screen, only a part (one quarter) of the screen is shown. You can move this display window of the screen using the arrows on the keypad. If you press **?**, the displayed quarter will follow the cursor.

To select an item, simply use the arrow key to move the cursor to the field you want. Then use the plus and minus keys to select a value for that field. The Save Value commands in the Exit Menu save the values currently displayed in all the menus.

To display a sub menu, use the arrow keys to move the cursor to the sub menu you want. Then press <Enter>. A pointer marks all sub menus.

6.4.1 BIOS Settings of DimmPC

Main menu

Legacy Diskette	**1.44/1.25 MB, 3 ½"**
Primary Master	**AUTO**
Primary Slave	**AUTO**

Advanced Menu

Reset Configuration Data	**No**
Halt On Errors	**No**
CPU Speed	**133 MHz**
ISA bus cycle duration:	**800 ns**

I/O Device Configuration submenu:

Local Bus IDE Adapter	**Enabled**
Floppy disk controller	**Enabled**
Base I/O address	**Primary**
Serial port A	**3F8h, IRQ4**
Serial port B	**2F8h, IRQ3**
Parallel Port	**Enabled, EPP, 378h**

Setup Boot Menu

Floppy Check	**Disabled**
Summary Screen	**Disabled**
QuickBoot Mode	**Enabled**
Dark Boot	**Disabled**

Boot Device Priority submenu:

+ Hard Drive
  - Add-on cards
  - SanDisk
  - Primary Slave
+ Removable Devices
  - Legacy floppy drives

CD ROM
Network Boot

6.4.2 Exit Menu

Exit Saving Changes
Saves all the selections and exits setup. The next time you boot, the BIOS configures the system according to the Setup selection stored in CMOS.

Exit Discarding Changes
Use this option to exit Setup without storing in CMOS any new selections you may have made. The selections previously in effect remain in effect.

Load Setup Defaults
Select to display the default values for all the Setup menus.

Discard Changes
If, during a Setup session, you change your mind about changes you have made and have not yet saved the values to CMOS, you can restore the values you previously saved to CMOS.

Save Changes
Saves all the selection without exiting Setup. You can return to the other menus if you want to review and change your selection.

Would you make a mistake, or get lost among settings, you can restore defaults anytime, by selecting “Load Setup Defaults” and starting all over again.

6.5 DOS Functions on the Instrument

To check the main board as a PC motherboard, or for other service actions, you may wish to run the instrument like a normal PC.
In this case an **MS-DOS** 6.22 operating system **boot floppy** disk is required.
Follow the steps below to boot from an MS-DOS diskette:

- Connect an external PS/2 keyboard
- After turning on, immediately press repeatedly F2 on the external keyboard, until you see the keyboard lights flashing on (or you hear beeps)
- Switch to MDA mode by **“?”** and **“.”**, and press ← and ↑ cursor keys on the keypad to stabilize screen
- Use arrows on the keyboard to go to the BOOT section of the menu, and go down to *Boot device priority* menu, press Enter
- The list shows the boot order, move the cursor to the item you wish to change, then press +/- on the keyboard to move it higher/lower in the list. Move *Removable devices* first.
- Press Esc key until you get to the Exit menu, and press Save changes, then Enter to confirm
- Put the MS-DOS boot floppy into the floppy disk drive

The instrument will boot from the floppy and after pressing Enter to accept date/time, you can use it as a DOS computer, where floppy is A: or B:, and SanDisk (Hard Disk) is C:

This mode gives facilities to the Service Personnel to run DOS functions (Scandisk) for checking the Hard Disk, the main board, and the floppy disk drive

Do not forget to set back Hard Disk first under boot order section, in the way specified above, otherwise Software Upgrade will not work, and the system will hang if a floppy disk will be left in the floppy drive during start-up.

6.6 Error messages

The analyzer checks the operation of several mechanic, fluidic and electronic parts during measurement. The system shows the type of the error on the LCD display if any kind of malfunction is detected.

The electronic parts have a very little chance to fail, only the connections and cables could get disconnected, which can cause malfunction of the electronic system. The mechanic and fluidic system have more chance to go wrong because it has moving parts.

6.6.1 Error code list

%s: filename concerned, %d: error type concerned, %u: error specific string

Code	Error text	Reason(s)	Remedy
1000	Out of memory in %s	Fatal system or program error!	Check the MPNIF card and DimmPC for proper insertion. Try to make a software upgrade.
1001	Error %d on opening file %s	Fatal system or program error!	The same as in case of error 1000.
1002	Cannot create file %s	Fatal system or program error!	The same as in case of error 1000.
1003	Data file %s is corrupt, new will be created, all stored measure data will be lost	Stored data file is corrupt or missing! Disk or software error.	New stored data file will be created automatically (by User confirmation).
1004	Error %d on indexing file %s	Fatal system or program error!	The same as in case of error 1000.
1100	Fatal pressure error. Power off the system!	Cannot make the measuring vacuum!!	Check the pump and the tubes, fittings and valves around the puffer reservoir.
1101	Waste is full! Empty waste container! The system assumes that you will do it before going on!	Waste container is full!	Empty waste container! If it is not full, there is a clogging in the waste sensor line (maybe Valve15 is not closed completely), or tube is pinched.
1102	Check Diluent container!	Diluent reagent container become empty, or the diluent fluid sensor is too sensitive or there are a lot of bubbles in the diluent tubes!	Replace the Diluent reagent container with a filled one. If this error still remains with a filled diluent reagent container, adjust the sensitivity of the diluent sensor and check the tubings and the fittings.
1103	Check Lyse container!	Lyse reagent container become empty, or the lyse fluid sensor is too sensitive or there are lot of bubbles in the lyse tubes!	Replace the Lyse reagent container with a filled one. If this error still remains with a filled lyse reagent container, adjust the sensitivity of the lyse sensor and check the tubings and the fittings.

Code	Error text	Reason(s)	Remedy
1104	Timeout. Try cleaning!	The float in the volume opto board did not reach the start or the stop position within a specified time!	1. Try cleaning (to remove clog). 2. Check the proper operation of the volume opto board and the float (opto switches, float, float house). 3. Check the fittings and the tubes around the volume opto board.
1105	Vacuum error	The measuring vacuum has been dramatically decreasing during the measurement or absolutely lost!	Leakage in the pneumatic system (check the pump, fittings, tubings, pressure sensor, puffer reservoir and valves).
1106	%s – Fatal pneumatic error: %s CMD: %u Power off the system! Example: “MVert: Ra error”	Motor error. One of the stepper motors could not reach a specified position, either it has not reached one of the end-switches, or it reached one without expecting to do so.	Check the proper operation of the motor modules (home/end opto switches, ribbon cables and the motor moving). MDilu = dilutor, MVert = vertical, MHori = horizontal motor St = step error, Ra = range error Possibly error due to lost steps of the corresponding stepper motor.
1107	Check Cleaner container!	Cleaner reagent container became empty, or the dil./clean fluid sensor is too sensitive or there are lot of bubbles in the cleaner tubes!	Replace the Cleaner reagent container with a filled one. If this error still remains with a filled cleaner reagent container, adjust the sensitivity of the dil./cleaner sensor and check the tubings and the fittings.
1200	Fatal “MeasInit” error. Power off the system!	Fatal MPNIF error.	Replace the MPNIF board.
1201	Fatal HGB error. Power off the system!	HGB channel did not give a ready signal!	Replace the MPNIF board.
1300	Cannot write archive data! Check disk! It may be unformatted, full or bad! Do you want to retry?	Cannot write archive data because some disk errors!	Replace the floppy disk.
1301	Cannot read archive data! Do you want to retry?	Archive disk is damaged or not an archive disk!	Change the floppy disk (archive).
1302	Cannot load archive data.	Disk is not an archive disk or damaged!	Change the floppy disk (archive).
1400	Printer error %d	Printer error!	Check the connections between the instrument and the printer and check the printer setup in the Settings/Printer settings sub-menu.
1401	Printer is out of paper and error %d	Printer is out of paper and there are some other printer errors!	Feed the printer with paper. Check the connections between the instrument and the printer and check the printer setup in the Settings/Printer settings sub-menu.
1402	Printer is out of paper	Printer is out of paper!	Feed the printer with paper.
1403	Printer was not set up correctly	The selected printer type does not match to the printer!	Modify the printer setup in the Settings/Printer settings sub-menu.
1404	Paper width is too large	Paper width steps over the margin!	Modify the paper setup in the Settings/Printer settings sub-menu.

Code	Error text	Reason(s)	Remedy
1405	Paper height is too large	Paper height steps over the margin!	Modify the paper setup in the Settings/Printer settings sub-menu.
1406	Paper width is too small	Paper width steps over the margin!	Modify the paper setup in the Settings/Printer settings sub-menu.
1407	Paper height is too small	Paper height steps over the margin!	Modify the paper setup in the Settings/Printer settings sub-menu.
1408	Left margin is too large	Left margin is too large!	Modify the margin setup in the Settings/Printer settings sub-menu.
1409	Top margin is too large	Top margin is too large!	Modify the margin setup in the Settings/Printer settings sub-menu.
1410	Spacing is too large	The distance between two results is too high!	Modify the vertical spacing setup in the Settings/Printer settings submenu.
1411	Error #%d in printer initialization!	Printer software error!	Check the connections between the instrument and the printer and check the printer setup in the Settings/Printer settings sub-menu. Try to make a software upgrade.
1900	You have to add at least one user to use multi user mode!	Multi-user problem	Follow the instruction, or change to single user mode in the User settings submenu.

6.6.2 Message code list

Code	Message text
5000	Are you sure to prepare the device to delivery?
5001	Remove reagent tubing at rear reagent inputs (Diluent, Lyse, and Cleaner).
5002	Connect min. 100 ml distilled water to reagent inputs using cleaning tube kit.
5003	Remove cleaning tube kit. Keep reagent inputs free.
5004	You can power off the system!
5005	Apertures are partially clogged. Try cleaning!
5006	Please empty waste container!
5100	%u data record(s) will be copied to the database.
5101	%u data record(s) is selected.
5102	Insert data disk!
5103	Insert data disk #%d of %d!
5104	%u data record(s) will be saved on %d disk(s). Insert an empty floppy disk!
5105	Insert next empty floppy disk!
5106	No such type of data
5200	Your previous QC data will be lost. Are you sure?
5300	Some or all of the calibration factors are out of range!
5900	This function is not available because there are no accepted blank values. Try blank measurement!
5901	Insert software update disk! The system will restart.
5902	Are you sure to delete all device statistics?
5903	This function will delete all measured results. Are you sure?
5904	This function will delete all selected records. Are you sure?
5905	Are you sure?

6.7 Problems related to Warning flags

In this section we give you examples and troubleshooting of common problems.

Problem	Possible reason	Remedy
WBC blank measurement error, C, B warning flags displayed, but the WBC histogram is correct (no noise).	The instrument measures the probe voltages for both apertures during the measurements. From these values (and from the measuring times) the analyzer can detect the clogging (C, c warning flags). If the WBC probe voltage is changed, the instrument will give a C warning flag, and the WBC value will have an E (error) flag. This fluctuation of the probe voltage can happen if the diluent reagent temperature is changed or there is a passage of the measuring current next to the aperture. It can be caused by bad aperture or the WBC chamber is damaged.	⇨ Replace the WBC measuring tube (aperture). ⇨ Check the WBC chamber and replace it, if it is damaged.
There is no backlight in the LCD Module.	If the LCD is blank, and the Self test shows electrode voltage and current is low, there is no high voltage in the system. The problem is that the inverter circuit that generates this high voltage is out of order, or there is no connection between the MPU-Amplifier-High Voltage boards. The high voltage board may be damaged.	⇨ Check the 34-pin and the 20-pin ribbon cables between the MPNIF – Amplifier – High Voltage boards. Reconnect if you find something loose. ⇨ Replace the High Voltage Board (HVB).
All measured parameters are 0, but HGB result is correct.	Shielded cable that connects MPNIF board to the Amplifier board is disconnected. In that case only the measured HGB value is available, because it comes through the ribbon cable.	⇨ Reconnect the shielded cable at both ends (MPNIF and Amplifier).
Analyzer always exits from the measurement with “Timeout error”.	The volume meter tube is not in lowest point.	⇨ Move the volume meter tube to the lowest position and check the orientation of the float within the tube.
WBC noise during measurements (blank and normal). Noise in the WBC histogram, S warning flag.	1. If there is not a good grounding in the system, the instrument can give such kind of errors. **HUMACOUNT PLUS/HUMACOUNT** has a shock protecting system that requires earth grounding. You must not operate the system without grounding. 2. This error can happen also if some other instruments (X-ray, monitor) are working near the instrument by making strong radiation, or from the same electrical outlet by generating fluctuation in the line, which causes noise. 3. Some extreme conditions (other reagent systems); this problem can happen with good grounding as well. In that case the blood samples make a thin fluidic film in the WBC draining tube (lipids + lysing reagent). This fluidic film conducts the noise to the WBC measuring electrode. To prevent the system from this problem, we recommend to use the built-in Autoclean procedure, which cleans up the fluidic film from the WBC draining tube with the cleaner reagent after every Xth measurement. The default value for the Autoclean cycles is 20 and it can be changed only from the Service menu.	⇨ Measure grounding quality with a voltage meter by measuring AC voltage between grounding and neutral. This voltage must be less than 1 Volt. If the mains outlet does not provide a good ground, you can make it by connecting **HUMACOUNT PLUS/HUMACOUNT** to a grounded conductor i.e. water tap, or other grounded piping. ⇨ If it is possible, find another place for HUMACOUNT PLUS / HUMACOUNT, which is not near the other instruments. Use your analyzer with an individual outlet or use line filters. ⇨ You should lower the Autoclean setting to 10.

6.8 Possible Causes of Noise

Generally high count of any particle - even if you think it should be low, or near zero - can be caused by NOISE, i.e. something interferes with measurement.
The most important thing in these cases to identify the source of the NOISE, otherwise we cannot protect the system against it.
NOISE can come from has several sources, and the different NOISE sources are added.
Sometimes we have to fight one of them, but sometimes more. Only one of them is enough to make problem.

6.8.1 Contaminated reagent

The most probable cause: real particles are in the reagent, and therefore the PLT blank is continuously high (e.g. always 30-40). You can easily sort out this case by replacing diluent by opening a new tank. PLT blank must go down is several blank measurements (below 10).
Another reason - which is HUMACOUNT specific: the PVC tube between the T-fitting – coming from nozzle 2 of Valve 5 – and nozzle 2 of Valve 12 should have a minimal length of 40 cm.
Please, check the length of this tube, because if a short tube is installed only, and the cleaner is contaminated, the PLT blank could not go down due to the diluent mixing with contaminated cleaner. This reason can be sorted out easily: replace the cleaner reagent with diluent, and PLT blank should go down.
How can a good reagent become bad by time?

- If the reagent tube was contaminated, and some bacteria begin to grow inside, once you put an infected reagent tube into a new tank, by time it can become infected as well, i.e. the background (PLT blank) becomes high. Wash the reagent tube - which is in connection with the reagent - with 1% of bleach solution, then rinse with clean distilled water or diluent. It can avoid the bacteria to grow inside.
- If tank is open – and cap is not installed or closed - external dust can make reagent dirty.

6.8.2 Bad earth grounding

In this case external - ground referenced - noise can get into the system by ground coupling. If system ground is not good enough, ground terminal can become a noise source as well, i.e. external signals will be coupled into the system instead of protecting it.
If no earth ground is available, you can use the 4 mm diameter screw at the rear panel to connect a ground potential to the case, so that noise immunity can be increased.
Measure voltage on ground terminal to make sure earth grounding is correct. AC voltage lower than 1V is accepted in this case.
At some places - as a bad practice - electricians like to connect earth ground terminal to neutral wire. Depending on the resistance of the neutral back wire (where it is really earthed), several volts can appear, and this way any inductive noise will be coupled into the instrument. It is better to create a real earth grounding and connecting it to the rear screw.

6.8.3 External electrical noise

If another instrument near HUMACOUNT can radiate electromagnetic signals in the 1 kHz - 100 kHz frequency region it can be picked up by the system (especially if they are very close to each other, or the grounding is not quite perfect).
You can easily identify this noise source: by relocating the instrument noise (high PLT blank) disappears. In this case you have to identify the possible noise source (switch mode power supplies, computer monitors, since they are not shielded, centrifuges due to high switching noise of rotor contacts, etc.), the power of the electromagnetic source, because if high power is present, maybe relocation does not solve your problems, sometimes the electric power supply makes the coupling, so UPS solves the problem.
Another source of coupling in external noise can be the reagent tanks and tubes. Especially radio transmitters can cause problems of radiating so that even the reagents (diluent) guides in the noise. A metal pack for the diluent tank, then a good earth grounding of this metal box allows the coupling to disappear forever.

6.8.4 Internal noise sources

The most annoying but real cause is some sort of internal noise. The reason for this phenomenon is that the inside electrode - hot point - of the measuring circuit must be well insulated from the surrounding electronics, otherwise inside noise sources can take their effect.

A. Bad chamber insulation:

- **bad shielding of the chamber** (floating shield couples signals to the chamber, and does not prevent against them). Check grounding of shield, remove it and clean the surface between the shield and the metal base.
- **bad reference electrode connection** (floating ground reference). Repair is required.
- **bad sealing of aperture**. Replacement of measuring tube is required.
- **broken measuring chamber** starts to conduct through the gaps (ground path). Replacement of chamber is required.
- **contaminated draining tube** starts to conduct due to protein or lipid build-up. It is very easy to identify this case. After replacing the drain tube of the measuring chamber (mainly WBC), WBC histogram peak, or PLT becomes low soon. Normally a good cleaner is required to dissolve lipid or protein build-up. Sometimes the cleaner is not strong enough to keep this tube clean enough. Periodic washing using 1% hand warm bleach solution helps.

B. Bad insulation of electronic signal paths:

In these cases check for any capacitive coupling of electronic signals to the chamber:

- **interference with HGB head** (high-frequency signal is coupled to the chamber). HGB head metal parts must be grounded. The ground comes externally, it must be in place, otherwise HGB head does not shield, but couples in noise.
- **interference with internal high voltage inverter** (high-frequency signal is coupled to the chamber). Repair is required: avoid near contact of HVB cable to chamber or shielded amplifier cable.
- **interference with internal start button** (polling signal to start button may cause noise). Guide start button wires as far from chamber as possible. You may try mix them up on the start micro-switch if applicable.
- **interference with display cable** (high-frequency LCD signal is coupled to the chamber by the ribbon cable). Keep the ribbon cable far from the chamber.
- **interference with CPU fan or other digital logic traces** (CPU fan or other digital signal radiates to chamber or to the shielded amplifier cable). Try keeping the ribbon cables far from the chamber and shielded cable.

C. Bad components, or connections:

- **bad soldering, salt residuals or component failure on amplifier** (especially if some reagent could get in the amplifier section). Cleaning of PCB/electrode socket or replacement of amplifier is required. Check for the correct soldering of reference cable and its connector.
- **MPNIF board bad soldering or component failure**. Check the shielded cable connections as well. Sometimes inside out connection (the hot electrode goes outside as a shield) is the problem: both ends of amplifier signal cable must be reversed.
- **analog signal ribbon cable** (it picks up noise). Check the ribbon cable between the MPNIF board and the amplifier. Maybe it is pinched under some screws or components. This may cause trouble and even noise.

D. Pneumatic failures, liquid paths that conduct noise into the chamber:

- **liquid remains under the chamber in drain tube** (during measurement the conducting liquid remains inside the drain tube making noise to appear there).
  - Check chamber draining path for clogging or salt crystals.
  - Check the pump operation. Since draining of the chamber goes under pressure control, maybe a bad pressure sensor or connection can cause trouble.
  - Clean the draining path. Do not use alcohol, but bleach. Replace chamber if necessary.
- **liquid remains in the washing inlet at top of the chamber** (during measurement the conducting liquid remains inside the chamber wash tube making noise to appear). The software is not compatible with the mechanics, or related valve is bad/partly clogged, or the tubing is clogged/loose.
- **lyse path guides in noise** (during counting, if the a liquid in the draining tube is touching lyse reagent in T-fitting, noise can appear). Check the lyse path, and the lyse valve as well.

7 MAINTENANCE

7.1 Weekly Maintenance by User

User should carry out on the first workday, before starting up the analyzer.

7.1.1 Cleaning the washing head

User should clean the lower surface of the aspirating tip washing head using a soft cloth, immersed in warm tap water to remove salt build-up.

7.2 Periodic Maintenance by Service

The instruments should be checked and maintenance must be carried out in every 6-12 months, or after 10 000 measurement cycles.

7.2.1 Check Self test and Device statistics

Run the built-in Self test and check the overall test result. Check the device statistics to find common problems.

7.2.2 Cleaning and Greasing Dilutor Block

The dilutor block driving wheels and gear bar should be cleaned from dirt and must be greased between the gear bar and the support, and between cogged wheels.

7.2.3 Checking and Lubricating Dilutor Piston Tips

The cogged end of PTFE dilutor pistons should be cleaned and lubricated by neutral silicon grease. Apply just a thin layer, and move it along the perimeter of the piston, so that some of the material goes into the gaps between the sealing rings.
Repeat this step for lyse and dilutor pistons as well. Check the condition of the micro piston sealing, and replace if necessary.

7.2.4 Cleaning and Lubricating Needle Moving Mechanics

The H&V moving mechanics sliding bars should be cleaned from dust.

Lubricating of the sliding bars must be made using „**Photorube**" oil containing PTFE. **Grease or pure lubricating oil is not suitable.**

7.2.5 Checking and Replacing Washing Head

Check the state of the washing head, and replace if necessary.

Perform correct adjustment of the needle height (see Section 4.1.2).

7.2.6 Checking and Replacing Peristaltic Pump Tube

Replace peristaltic pump tube if needed. You can check it by opening the lock, and removing the tube for inspection.
Check for leakage of the tubing. Reassemble the head.

Warning! Be careful, DO NOT twist the tube while reposition it into the head, because it will cause malfunction in a very short period of time.

7.2.7 Checking of the Power Supply

Open the instrument for regular cleaning inside. Check the cleanliness and operation of the cooling fan of the power supply. Clean or replace the fan if necessary.

7.2.8 Bleaching of Fluidic System

It is recommended to run a bleaching procedure to remove stains from the fluidic system.

1. Connect 2-5%, hand warm, clean bleach solution to all reagent inputs, and perform priming on all reagent inputs.
2. Leave it in the tubing for not more than 2-3 minutes.
3. Remove bleach, and prime all on air.
4. Connect distilled water (100 ml), and perform priming all reagents, again.
   Connect reagents, and run priming again.

8 SPARE PARTS

CODE	NAME	HUMACOUNT	HUMACOUNT PLUS
A130	Front panel (HUMACOUNT PLUS, complete)		*
A131	Front panel (HUMACOUNT PLUS, excl. keyboard)		*
A132	Foil keyboard (HUMACOUNT PLUS)		*
A133	HVB board with inverter (complete)	*	*
A136	LCD display	*	*
A137	Lamp for LCD	*	*
A140	Amplifier board (HUMACOUNT PLUS, complate)		*
A154	Floppy drive	*	*
A156	Power supply	*	*
A157	Mains switch	*	*
A159	Loudspeaker	*	*
A160	MPNIF board (complete)	*	*
A170	IDEEPROM board	*	*
A191	MB4 motherboard for DimmPC	*	*
A192	DimmPC (CPU)	*	*
A193	Heat sink for DimmPC	*	*
A194	Connector holding plate	*	*
A195	DimmPC safe ring	*	*
A196	MB4 motherboard holding plate (HUMACOUNT PLUS)		*
A300	XY needle movement block (complete)	*	*
A301	Timing belt for XY block	*	*
A302	Stepper motor	*	*
A303	Bearing for XY block	*	*
A304	Timing pulley for X (mounted)	*	*
A305	Timing pulley for Y (mounted)	*	*
A306	Gear for Y opto	*	*
A307	H&V motor opto board (complete)	*	*
A308	Opto switch I.	*	*
A309	Opto switch II.	*	*
A310	Head washer	*	*
A311	Aspirator tip	*	*
A313	Seeger ring (D 19)	*	*
A314	Seeger ring (RA5)	*	*
A321	Return pulley for XY	*	*
A400	Meas. Block excl. Amplifier (HUMACOUNT PLUS)		*
A401	Cone for chambers	*	*
A402	Sealing ring for chamber	*	*

CODE	NAME	HUMACOUNT	HUMACOUNT PLUS
A403	U-shaped metal fixing for apertures	*	*
A404	Cone for WBC chamber	*	*
A405	Shield for WBC chamber	*	*
A410	MIX chamber		*
A420	RBC chamber	*	*
A421	RBC aperture (80 µm)	*	*
A422	Ground electrode for RBC/WBC	*	*
A430	WBC chamber		*
A431	WBC aperture		*
A433	Upper part for WBC chamber		*
A434	HGB meas. head (complete)	*	*
A440	Complete VMOP board (A441+A442)		*
A441	VMOP volume limiter board (only PCB)		*
A442	Volume limiter tube		*
A500	Pneumatic block excl. measuring head, DIL, XY		*
A501	Valve unit I. (HUMACOUNT PLUS,compl. valve 1-5)		*
A502	Valve unit II.(HUMACOUNT PLUS,compl. valve 6-9)		*
A503	Valve u. III.(HUMACOUNT PLUS,compl.valve11-15)		*
A504	2/2 valve	*	*
A505	3/2 valve	*	*
A506	Valve coil for both valves	*	*
A507	2/2 valve head	*	*
A508	3/2 valve head	*	*
A510	Puffer reservoir HUMACOUNT PLUS		*
A511	Puffer reservoir holder (pair)	*	*
A530	PCPRO pressure board (complete)	*	*
A531	Pressure sensor	*	*
A532	Reagent sensor tube for PCPRO board	*	*
A541	4/2 plastic tube (silicon)	*	*
A542	5/3 plastic tube (silicon)	*	*
A543	4/1.8 Tygon tube	*	*
A544	5/3 reagent tube	*	*
A545	3,2 mm T connector	*	*
A546	Y connector	*	*
A547	2,3/3,2 fitting	*	*
A548	O ring for WBC chamber	*	*
A549	O ring for apertures	*	*

CODE	NAME	HUMACOUNT	HUMACOUNT PLUS
A550	Diluent cont. connector	*	*
A551	Colour locking ring	*	*
A552	Colour lock nut (inside)	*	*
A553	Colour coding ring (outside)	*	*
A554	Luer female	*	*
A555	Luer male	*	*
A556	2,3 mm T connector	*	*
A557	Teflon regent cont. Connector	*	*
A558	Reagent tubing set (HUMACOUNT PLUS)		*
A559	Reagent tubing set (HUMACOUNT)	*	
A560	Peristaltic pump	*	*
A561	Tube for peristaltic pump	*	*
A563	Cassette for pump	*	*
A564	Fixing for pump (pair)	*	*
A565	Connector for pump (pair)	*	*
A600	Body (HUMACOUNT PLUS, mounted)		*
A610	Micro switch	*	*
A611	Sampling bar (HUMACOUNT PLUS, mounted)		*
A612	Gloving LED cover (HUMACOUNT PLUS, plastic)		*
A613	Gloving LED cover board (complete)		*
A620	Instrument door (HUMACOUNT PLUS)		*
A623	Magnet for door	*	*
A630	Upper body cover (HUMACOUNT PLUS, plastic)		*
A640	Instrument foot	*	*
A650	Screw for loudspeaker	*	*
A660	HUMACOUNT PLUS cover with HUMAN logo		*
A661	HUMACOUNT PLUS cover without logo		*
A662	HUMACOUNT cover with HUMAN logo	*	
A663	HUMACOUNT cover without logo	*	
A701	Mains cable	*	*
A712	X motor cable (HUMACOUNT PLUS)		*
A713	Y motor cable (HUMACOUNT PLUS)		*
A714	Dilutor cable (HUMACOUNT PLUS)		*
A715	Keyboard cable (HUMACOUNT PLUS)		*
A716	LCD cable (HUMACOUNT PLUS)		*
A717	Valve I. (1-5) cable (HUMACOUNT PLUS)		*
A718	Valve II. (6-10) cable (HUMACOUNT PLUS)		*

CODE	NAME	HUMACOUNT	HUMACOUNT PLUS
A719	Valve III. (11-15) cable (HUMACOUNT PLUS)		*
A720	Pressure board cable (HUMACOUNT PLUS)		*
A721	Amplifier board cable I. (HUMACOUNT PLUS)		*
A722	Amplifier board cable II. (HUMACOUNT PLUS)		*
A723	HVB board cable (HUMACOUNT PLUS)		*
A724	COMS&KEY connector PCB	*	*
A725	COMS&KEY ribbon cable	*	*
A726	LPT&USB connector PCB	*	*
A727	LPT&USB ribbon cable	*	*
C130	Front panel (HUMACOUNT, complete)	*	
C131	Front panel (HUMACOUNT, excl. keyboard)	*	
C132	Foil keyboard (HUMACOUNT)	*	
C140	Amplifier board (HUMACOUNT, complete)	*	
C196	MB4 motherboard holding plate (HUMACOUNT)	*	
C400	Meas. Block excl. Amplifier (HUMACOUNT)	*	
C406	Upper part for HUMACOUNT chamber	*	
C500	Pneumatic block excl. measuring head, DIL, XY	*	
C501	Valve unit I. (HUMACOUNT, complete, valve 1-5)	*	
C503	Valve u. III. (HUMACOUNT, complete, valve11-15)	*	
C510	Puffer reservoir HUMACOUNT	*	
C600	Body (HUMACOUNT, mounted)	*	
C611	Sampling bar (HUMACOUNT, mounted)	*	
C612	Gloving LED cover (HUMACOUNT, plastic)	*	
C620	Instrument door (HUMACOUNT)	*	
C621	Joint-hinge for door (HUMACOUNT)	*	
C624	Body cover (HUMACOUNT)	*	
C630	Plastic front body (HUMACOUNT, plastic)	*	
C712	X motor cable (HUMACOUNT)	*	
C713	Y motor cable (HUMACOUNT)	*	
C714	Dilutor cable (HUMACOUNT)	*	
C715	Keyboard cable (HUMACOUNT)	*	
C716	LCD cable (HUMACOUNT)	*	
C717	Valve I. (1-5) cable (HUMACOUNT)	*	
C719	Valve III. (11-15) cable (HUMACOUNT)	*	
C720	Pressure board cable (HUMACOUNT)	*	

CODE	NAME	HUMACOUNT	HUMACOUNT PLUS
C721	Amplifier board cable I. (HUMACOUNT)	*	
C722	Amplifier board cable II. (HUMACOUNT)	*	
C723	HVB board cable (HUMACOUNT)	*	
S200	Dilutor block (complete)	*	*
S203	Micro syringe	*	*
S204	Micro piston	*	*
S205	Micro piston sealing part	*	*
S209	Track	*	*
S210	Bearing for dilutor	*	*
S211	Seeger ring	*	*
S214	Dilutor panel (mounted)	*	*
S221	Macro syringe+piston	*	*
S222	Lyse syringe+piston	*	*

9 APPENDICES

9.1 Warning Flags

Flag	Meaning	Recommended user action
W	WBC three part warning or WBC three part diff. Unsuccessful	⇒ Repeat the measurement. Possibly lyse problem. ⇒ Check the discriminators in the WBC histogram. If the discriminators are in the proper place (the populations can be separated by eye) then the results are correct.
E	No WBC three part	⇒ Possibly lyse problem, but in some pathological samples (too high lymphocytes), it can be happened.
H	HGB blank is high, or no HGB blank	⇒ Repeat the blank measurement and accept it. ⇒ Possibly lyse or diluent problem.
B	WBC blank is high, or no WBC blank	⇒ Repeat the blank measurement and accept it. ⇒ Possibly lyse or diluent or noise problem.
L	WBC/RBC limit warning	⇒ Check the 1. RBC-LYM discriminator. If it is in the minimum point (or close to it), accept the results. Otherwise repeat the measurement. ⇒ If the retried action makes very similar results and the discriminator is in a wrong place then the MID and GRA results are OK, but the WBC and LYM results can be higher because of the RBCs.
R	Too many RBC cut from WBC	⇒ Repeat the measurement. Possibly lyse problem. ⇒ If the WBC measuring time is too high (more than 8 sec.) it could be aperture clogging. In that case perform cleaning and repeat the measurement.
M	WBC coincidence is too high. Linearity error.	⇒ The results are out of the linearity range. Make a dilution with an external dilutor with a pre-defined dilution range. Do not forget to correct the results with the defined factor.
D	WBC data package errors	⇒ Perform cleaning and repeat the measurement (aperture clogging). ⇒ If it is a general problem, please call your Service Personnel.
S	WBC time error	⇒ The same action as in case of the **D** warning flag.
C	WBC clogging	⇒ Aperture clogging. The same action as in case of the **D** warning flag.
P	PLT blank is high, or no PLT blank	⇒ Repeat the blank measurement and accept it. ⇒ Diluent problem. Replace diluent, open a new tank.
B	RBC blank is high, or no RBC blank	⇒ Repeat the blank measurement and accept it. ⇒ Diluent problem. Replace diluent, open a new tank.
L	RBC/PLT limit warning	⇒ The RBC/PLT valley is too high. It is rather a diagnostic flag. If the discriminator is in a wrong place (in the PLT or RBC histogram) then repeat the measurement for a correct PLT result.
K	RBC peak warning	⇒ Perform cleaning and repeat the measurement (clogging). ⇒ If it is a general problem, change the RBC aperture.
M	RBC/PLT coincidence is too high. Linearity error.	⇒ The same action as in case of the **M** warning flag.
D	RBC/PLT data package errors	⇒ The same action as in case of the **D** warning flag.
S	RBC/PLT time error	⇒ The same action as in case of the **D** warning flag.
C	RBC/PLT clogging	⇒ The same action as in case of the **C** warning flag.

9.2 Serial Communication Protocol (V2.x)

9.2.1 General Description

The HUMACOUNT PLUS/HUMACOUNT software is able to make serial connection link to a receiver device (e.g. computer) which is connected to the serial port. If the Baud Rate setting in the Service Menu is set to a valid value (other than Not Connected), the instrument will try to initiate a communication sequence.

The serial communication is always initiated by HUMACOUNT PLUS/HUMACOUNT, and the receiver must respond to this.

The hardware protocol: **8 data bit, 1 stop bit, no parity**. If the other side is not responding in 1 second, the instrument will repeat the transmission twice, but if still no response, the other side will be supposed to be not ready to receive data, and thus HUMACOUNT PLUS/HUMACOUNT will not try to communicate any more.

From this state it can wake up by receiving an <ENQ> (ASCII code 5) character from the other side, and the instrument will immediately respond an <ACK> (ASCII code 6). From this point the instrument will send data if it is ready for transmission.

The communication is based on packages. There are 5 package types:

- INIT package: Device identification, software version, current date and time.
- DATA package: Sample and patient information, measured parameters, and markers.
- RBC package: Sample information, RBC histogram.
- WBC package: Sample information, WBC histogram.
- PLT package: Sample information, PLT histogram.

The communication sequence is always started with an INIT package. If the link is successful, the instrument will send DATA package, and the receiver can request RBC, WBC and PLT packages at acknowledge.

Special characters used in the communication:

Character	ASCII code
<SOH>	1
<STX>	2
<ETX>	3
<EOT>	4
<ENQ>	5
<ACK>	6
<HT>	9
<LF>	10
<NAK>	21
<SPACE>	32

9.2.2 Format of Packages Sent by HUMACOUNT PLUS/HUMACOUNT

The packages sent by HUMACOUNT PLUS/HUMACOUNT are always between a <SOH> and <EOT> character, and they consist of header, data and tail. The header consists of a package identifier and a package type descriptor. The tail includes the checksum. Typical format:

<SOH>MID CMD**<STX>**MESSAGE**<ETX>**CHKSUM**<EOT>**

MID: Message ID, one capital letter between 'A' and 'Z'

CMD: Command, one capital letter, package type descriptor

- 'I' for INIT;
- 'D' for DATA;
- 'R' for RBC;
- 'W' for WBC;
- 'P' for PLT.

MESSAGE: the message consists of ASCII characters (between 32..128)

CHKSUM: two hexadecimal digits of a one-byte checksum which contains the lower byte of the sum of characters between the <SOH> and <ETX> (incl. Those, too).

9.2.3 Format of Acknowledge of the Receiver

The receiver must acknowledge transmission by the following message:

<ACK>CMD MID

CMD: the type of the next package to send – this makes possible to a request for histograms. If no more packages are required, <SPACE> should be sent.

MID: the identifier of the package that acknowledged by this message.

If receiving of the message was not successful, <NAK> should be sent, and HUMACOUNT PLUS/HUMACOUNT will repeat the last package.

The receiver has approx. 1 second to reply, otherwise HUMACOUNT PLUS/HUMACOUNT will repeat the last transmission, twice automatically. But if still no response after 3 trials, HUMACOUNT PLUS/HUMACOUNT will not start to communicate any more, even if there is data to send (see General Description).

9.2.4 Detailed Description of Packages

The packages sent by HUMACOUNT PLUS/HUMACOUNT are placed between a header and a tail. There are 3 main types of them: INIT, DATA and histogram packages. The histogram package can be: RBC, WBC, and PLT. Their format is the same, the type descriptor differs only.

9.2.5 INIT package

HUMACOUNT PLUS/HUMACOUNT sends the general identifiers by this package during initiation of a communication:

DEVICE**<HT>**VERSION**<HT>**DATE**<HT**>TIME

DEVICE: device identifier

VERSION: version of the software, e.g. „2.7"

DATE: date in YYYYMMDD format

TIME: time in HHMMSS format

9.2.6 DATA package

This package contains sample and patient data, the measured parameters and the markers of histograms. One data element consists of two items: name and value, which are separated by a <HT> character, and closed by <LF>.

Important! SNO, DATE, TIME, SID and PID fields will always be present in this order, but other fields may be omitted.

SNO**<HT>**152**<LF>**	internal identifier
DATE**<HT>**19980715**<LF>**	date of measurement (YYYYMMDD)
TIME**<HT>**114500**<LF>**	time of measurement (HHMMSS)
SID**<HT>**1AXX435**<LF>**	sample identifier (alphanumeric)
PID**<HT>**B72D44**<LF>**	patient identifier (alphanumeric)
NAME**<HT>**JOE SMITH**<LF>**	patient name (alphanumeric)
BIRTH**<HT>**19650208**<LF>**	birthdate of patient (YYYYMMDD)
SEX**<HT>**0**<LF>**	patient sex (0-male, 1-female)
DOC**<HT>**Dr John Gold**<LF>**	doctor's name
OPID**<HT>**1172**<LF>**	operator identifier (alphanumeric)
MODE**<HT>**0**<LF>**	patient type
WRN**<HT>**0**<LF>**	warning bits[1] (32-bit hexadecimal)
PM1**<HT>**12**<LF>**	PLT lower marker[2]
PM2**<HT>**204**<LF>**	PLT upper marker[2]
RM1**<HT>**51**<LF>**	RBC lower marker[2]
WM1**<HT>**23**<LF>**	WBC upper marker[2]
WM2**<HT>**57**<LF>**	WBC LYM-MID marker[2]
WM3**<HT>**92**<LF>**	WBC MID-GRA marker[2]
PARN**<HT>**22**<LF>**	number of parameters to send
P01**<HT>** 6.6**<HT>**0**<LF>**	first parameter ID[3,] value and flag[4]
P02**<HT>**4.29**<HT>**0**<LF>**	second parameter ID, value and flag
...	
P22**<HT>** 8.2**<HT>**0**<LF>**	last parameter ID, value and flag

Remarks:

[1] Position and meaning of the warning flags:

Bit	Mask	Letter	Meaning
0	0x00001	c	RBC/PLT clogging.
1	0x00002	s	RBC/PLT time error.
2	0x00004	d	RBC/PLT data package errors.
3	0x00008	m	RBC/PLT coincidence is too high. Linearity error.
4	0x00010	k	RBC peek warning.
5	0x00020	l	RBC/PLT limit warning.
6	0x00040	b	RBC blank is high, or no RBC blank.
7	0x00080	p	PLT blank is high, or no PLT blank.
8	0x00100	C	WBC clogging.
9	0x00200	S	WBC time error.
10	0x00400	D	WBC data package errors.
11	0x00800	M	WBC coincidence is too high. Linearity error.
12	0x01000	R	Too many RBC cut from WBC.
13	0x02000	L	WBC/RBC limit warning.
14	0x04000	B	WBC blank is high, or no WBC blank.

15	0x08000	H	HGB blank is high, or no HGB blank.
16	0x10000	E	No WBC three part.
17	0x20000	W	WBC three part warning or WBC three part diff. Unsuccessful.

[2] The markers are given in histogram channel between 0 and 255, where 0 means that the marker could not be found.

[3] The parameter Ids in HUMACOUNT PLUS/HUMACOUNT are: P01: WBC (10^9/l); P02: RBC (10^{12}/l); P03: HGB (g/l); P04: HCT (%); P05: MCV (fl); P06: MCH (pg); P07: MCHC (g/l); P08: PLT (10^9/l); P09: PCT (%); P10: MPV (fl); P11: PDWsd (fl); P12: PDWcv (%); P13: RDWsd (fl); P14: RDWcv (%); P15: LYM (10^9/l); P16: MID (10^9/l); P17: GRA (10^9/l); P18: LYM% (%); P19: MID% (%); P20: GRA% (%); P21: RBCtime (sec); P22: WBCtime (sec).

[4]The parameter value is always 4 character wide, spaces from left added if necessary. It can be 9999, if the value could not be displayed in 4 digits, or ---- if the value could not be calculated because of an error.

The meaning of the parameter flags:

Flag	Displayed	Meaning
0		Value correct.
1	+	Value high (more than upper limit)
2	–	Value low (less than lower limit)
3	*	Value is unreliable.
4	E	Value not given because of error. Value is ----.
5		Value cannot be calculated. There is no value!

RBC, WBC and PLT package

The format of the histogram packages are the same, they differ in type descriptor only. The package contains the sample data (to identify the package) and the histogram.

SNO**<HT>**152**<LF>**	internal identifier
DATE**<HT>**19980715**<LF>**	date of measurement (YYYYMMDD)
TIME**<HT>**114500**<LF>**	time of measurement (HHMMSS)
SID**<HT>**1AXX435**<LF>**	sample identifier (alphanumeric)
PID**<HT>**B72D44**<LF>**	patient identifier (alphanumeric)
CHN**<HT>**256**<LF>**	number of histogram channels (256)
9**<HT>**	value of first histogram channel
...	
1**<HT>**	value of 255th histogram channel

value of the last histogram channel

9.2.7 Transmission Example

Let us suppose that the receiver was not ready to receive when HUMACOUNT PLUS/HUMACOUNT was switched on, therefore the instrument is not starting a communication.

Receiver sends that it is ready to receive now, HUMACOUNT PLUS/HUMACOUNT sends acknowledge.

<ENQ>

<ACK>

HUMACOUNT PLUS/HUMACOUNT sends INIT next time to initiate link (there is data to send):

V1.7 software:

<SOH>AI<STX>HUMAN HUMACOUNT PLUS<HT>1.7g<HT>20010405<HT>163902<ETX>88<EOT>

V2.x software:

<SOH>AI<STX>HUMACOUNT PLUS<HT>2.15a<HT>20010405<HT>160734<ETX>E4<EOT>

Receiver sends acknowledge:

<ACK><SPACE>A

HUMACOUNT PLUS/HUMACOUNT sends DATA package:

<SOH>BD<STX>SNO<HT>1<LF>DATE<HT>20010405<LF>TIME<HT>163800<LF>SID<HT>1<LF>PID<HT><LF>NAME<HT><LF>BIRTH<HT>00000000<LF>SEX<HT>0<LF>DOC<HT><LF>OPID<HT>0<LF>MODE<HT>0<LF>WRN<HT>0<LF>PM1<HT>10<LF>PM2<HT>135<LF>RM1<HT>34<LF>WM1<HT>21<LF>WM2<HT>55<LF>WM3<HT>91<LF>PARN<HT>22<LF>P01<HT>6.4<HT>0<LF>P02<HT>4.36<HT>0<LF>P03<HT>131<HT>0<LF>P04<HT>39.0<HT>0<LF>P05<HT>90<HT>0<LF>P06<HT>30.0<HT>0<LF>P07<HT>335<HT>0<LF>P08<HT>262<HT>0<LF>P09<HT>0.24<HT>0<LF>P10<HT>9.2<HT>0<LF>P11<HT>12.0<HT>0<LF>P12<HT>36.9<HT>0<LF>P13<HT>52.3<HT>1<LF>P14<HT>16.3<HT>0<LF>P15<HT>2.1<HT>0<LF>P16<HT>0.5<HT>0<LF>P17<HT>3.7<HT>0<LF>P18<HT>33.4<HT>0<LF>P19<HT>7.8<HT>1<LF>P20<HT>58.8<HT>0<LF>P21<HT> 8.4<HT>0<LF>P22<HT> 5.0<HT>0<LF><ETX>89<EOT>

Receiver acknowledges DATA transmission, and requests for RBC package:

<ACK>RB

HUMACOUNT PLUS/HUMACOUNT sends RBC package:

<SOH>CR<STX>SNO<HT>1<LF>DATE<HT>20010405<LF>TIME<HT>163800<LF>SID<HT>1<LF>PID<HT>57290<LF>CHN<HT>256<LF>4<HT>9<HT>17<HT>27<HT>37<HT>48<HT>58<HT>66<HT>70<HT>72<HT>70<HT>66<HT>60<HT>54<HT>47<HT>39<HT>33<HT>28<HT>22<HT>18<HT>15<HT>11<HT>9<HT>8<HT>7<HT>5<HT>4<HT>4<HT>3<HT>3<HT>2<HT>2<HT>1<HT>1<HT>0<HT>0<HT>0

HUMACOUNT PLUS/HUMACOUNT sends WBC package:

<SOH>DW<STX>SNO<HT>1<LF>DATE<HT>20010405<LF>TIME<HT>163800<LF>SID<HT>1<LF>PID<HT>57290<LF>CHN<HT>256<LF>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>255<HT>255<HT>255<HT>251<HT>209<HT>163<HT>118<HT>82<HT>56<HT>40<HT>32<HT>29<HT>29<HT>30<HT>34<HT>40<HT>47<HT>55<HT>64<HT>76<HT>88<HT>103<HT>119<HT>136<HT>155<HT>174<HT>195<HT>215<HT>233<HT>246<HT>254<HT>255<HT>249<HT>240<HT>227<HT>213<HT>200<HT>187<HT>176<HT>164<HT>153<HT>141<HT>129<HT>118<HT>108<HT>99<HT>92<HT>86<HT>81<HT>76<HT>71<HT>67<HT>64<HT>62<HT>61<HT>60<HT>60<HT>60<HT>57<HT>55<HT>51<HT>47<HT>44<HT>43<HT>42<HT>42<HT>43<HT>44<HT>45<HT>47<HT>47<HT>46<HT>45<HT>43<HT>40<HT>37<HT>34<HT>32<HT>30<HT>30<HT>30<HT>30<HT>29<HT>28<HT>26<HT>24<HT>21<HT>19<HT>17<HT>15<HT>14<HT>13<HT>12<HT>13<HT>13<HT>13<HT>13<HT>13<HT>12<HT>11<HT>11<HT>11<HT>12<HT>12<HT>14<HT>15<HT>16<HT>17<HT>17<HT>17<HT>17<HT>17<HT>17<HT>17<HT>17<HT>17<HT>18<HT>19<HT>21<HT>22<HT>23<HT>24<HT>25<HT>25<HT>25<HT>26<HT>29<HT>31<HT>34<HT>35<HT>36<HT>36<HT>35<HT>35<HT>35<HT>37<HT>38<HT>41<HT>43<HT>46<HT>47<HT>48<HT>50<HT>52<HT>56<HT>60<HT>64<HT>70<HT>74<HT>79<HT>82<HT>86<HT>89<HT>92<HT>95<HT>99<HT>102<HT>103<HT>104<HT>105<HT>105<HT>106<HT>108<HT>110<HT>112<HT>115<HT>117<HT>119<HT>120<HT>121<HT>120<HT>120<HT>120<HT>121<HT>122<HT>125<HT>129<HT>132<HT>136<HT>139<HT>141<HT>142<HT>142<HT>140<HT>138<HT>135<HT>132<HT>129<HT>127<HT>125<HT>123<HT>122<HT>120<HT>117<HT>115<HT>112<HT>109<HT>108<HT>108<HT>109<HT>110<HT>110<HT>108<HT>104<HT>99<HT>94<HT>89<HT>85<HT>82<HT>80<HT>79<HT>78<HT>77<HT>75<HT>72<HT>68<HT>63<HT>58<HT>54<HT>50<HT>47<HT>44<HT>43<HT>41<HT>41<HT>42<HT>42<HT>42<HT>42<HT>39<HT>37<HT>34<HT>30<HT>28<HT>25<HT>24<HT>23<HT>22<HT>22<HT>21<HT>21<HT>19<HT>17<HT>13<HT>9<HT>5<ETX>F7<EOT>

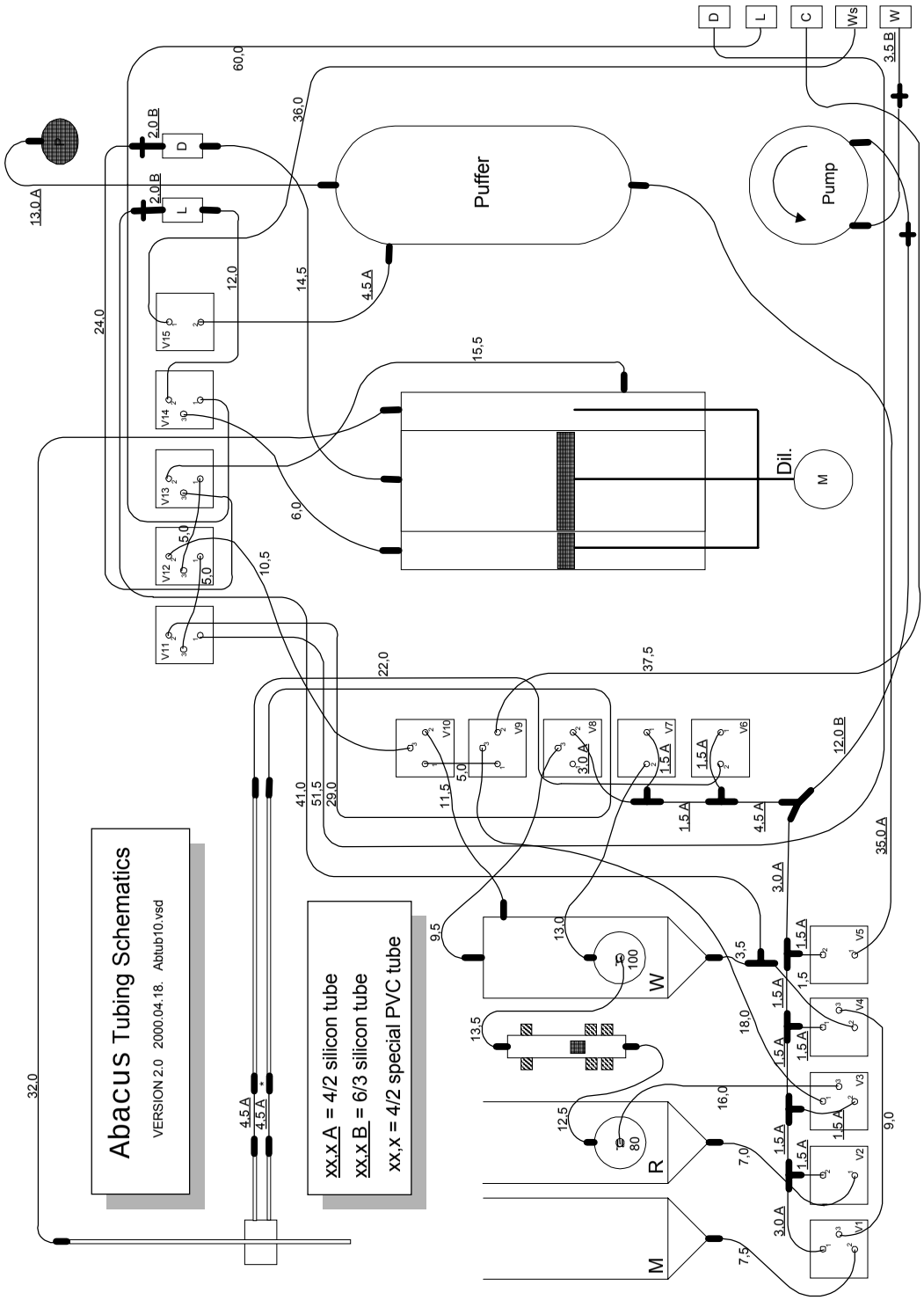
Receiver acknowledges WBC transmission, and closes the link. It is possible to request for PLT histogram if the acknowledge contains a “P” instead of <SPACE>, but it is not shown in this example.

<ACK><SPACE>D

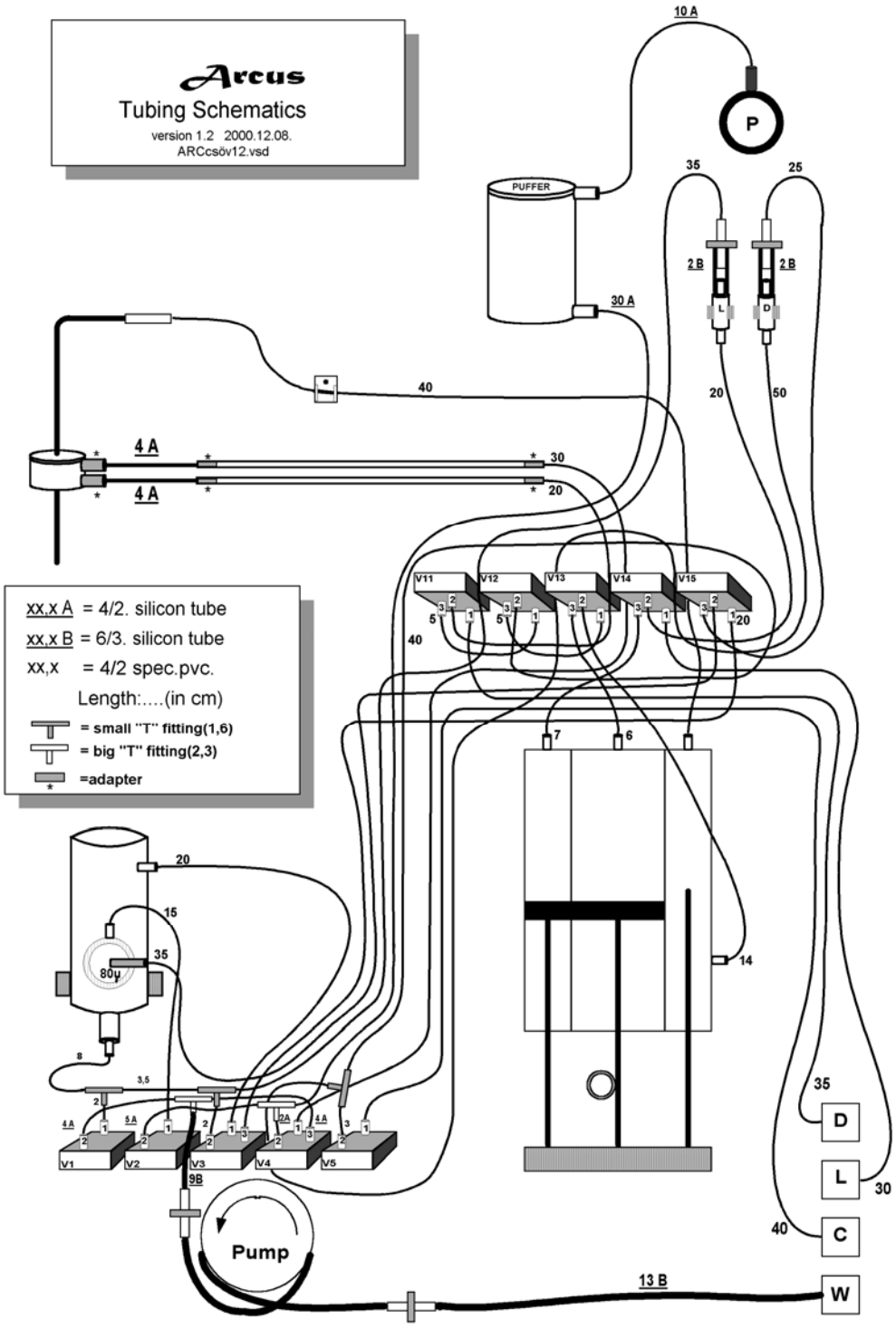
9.3 Recommended kit of tools

- PC standard keyboard
- Screwdrivers:
  - Cross Slot Screwdrivers (Philips)
  - Slot Screwdrivers
  - Hexagon Screwdrivers (3.5, 2.5, 2.0, 1.5 mm sizes)
- Pocket digital multimeter
- Diagonal Cutter (plier)
- Nipper

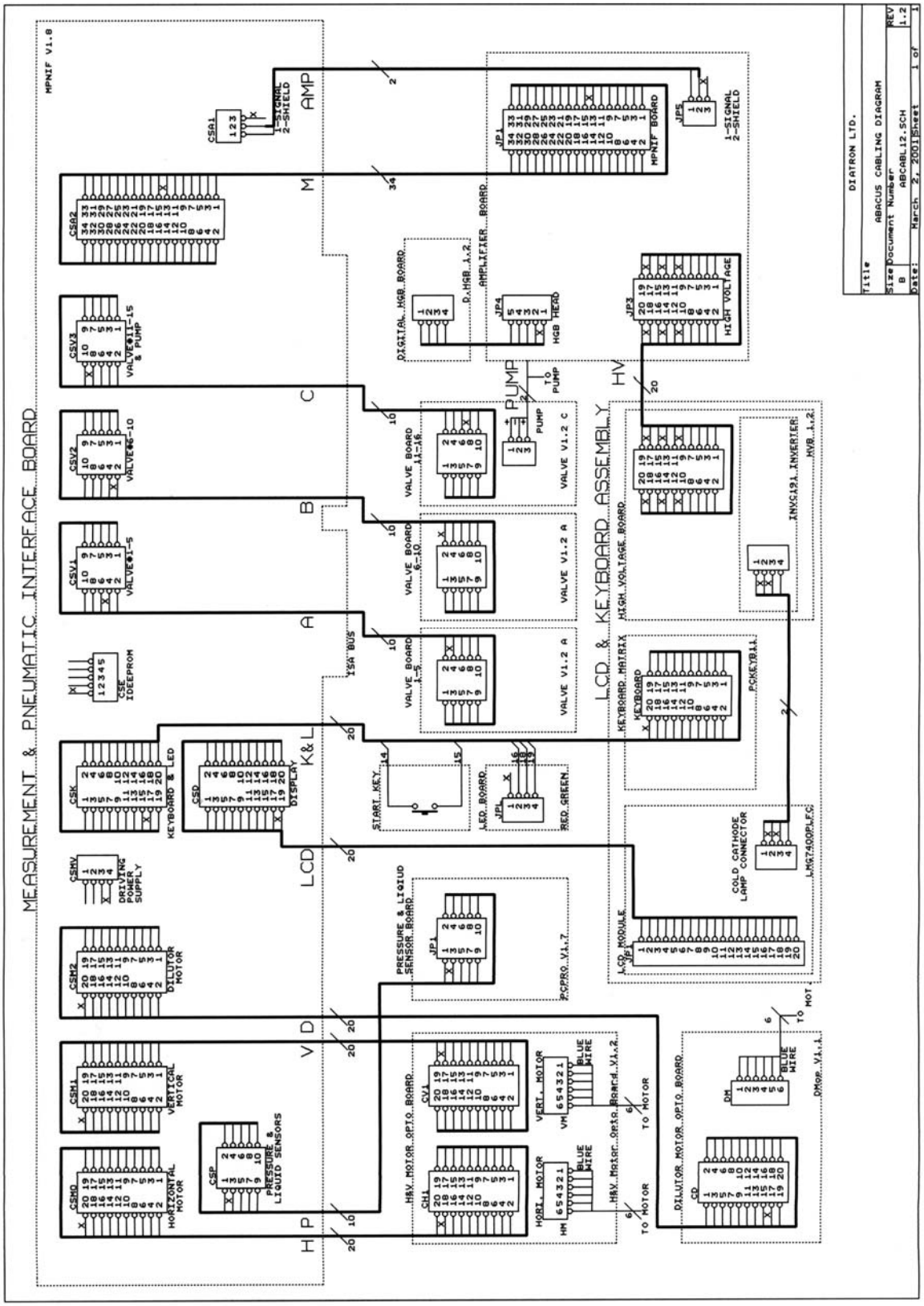
9.4 HUMACOUNT PLUS tubing schematic



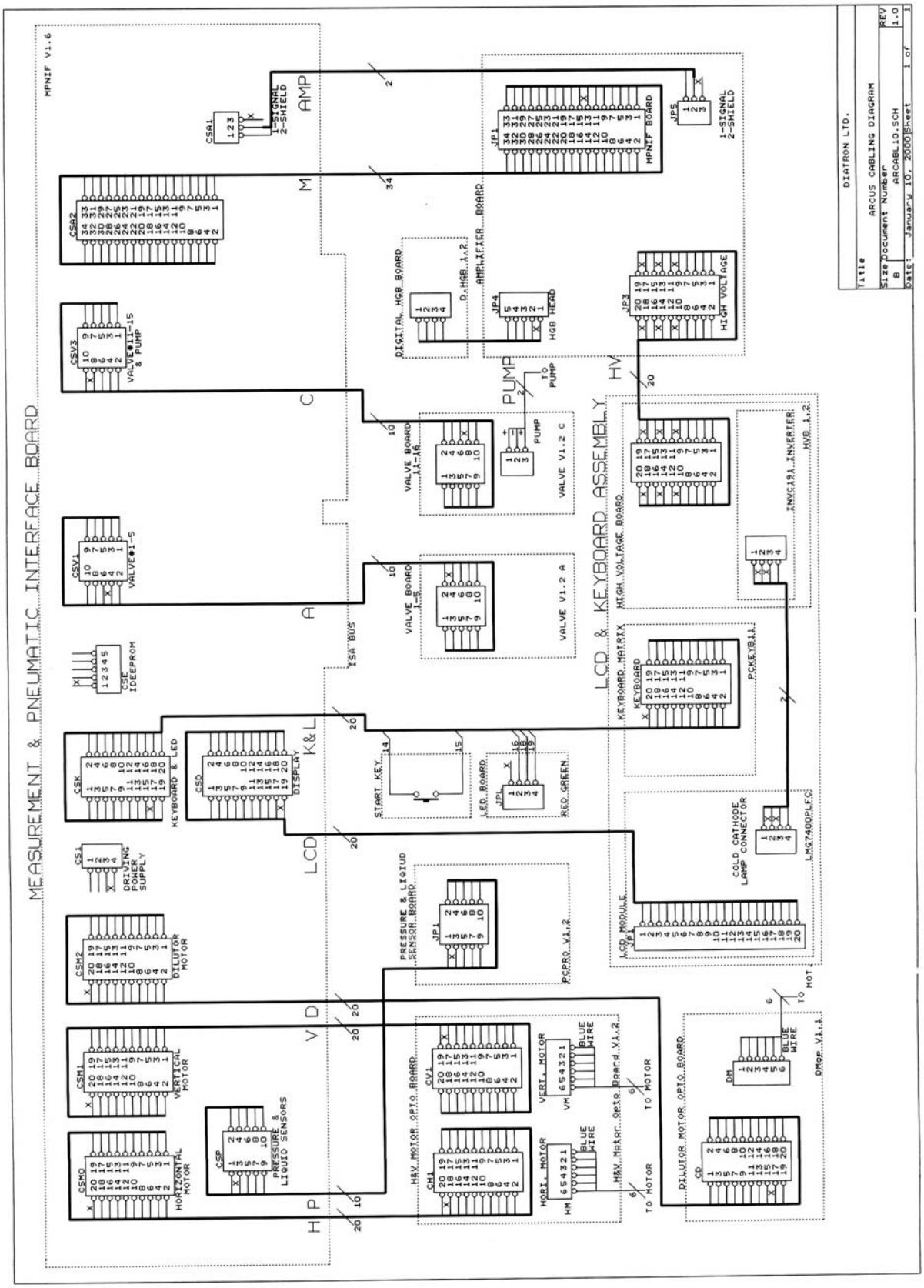
9.5 HUMACOUNT tubing schematic



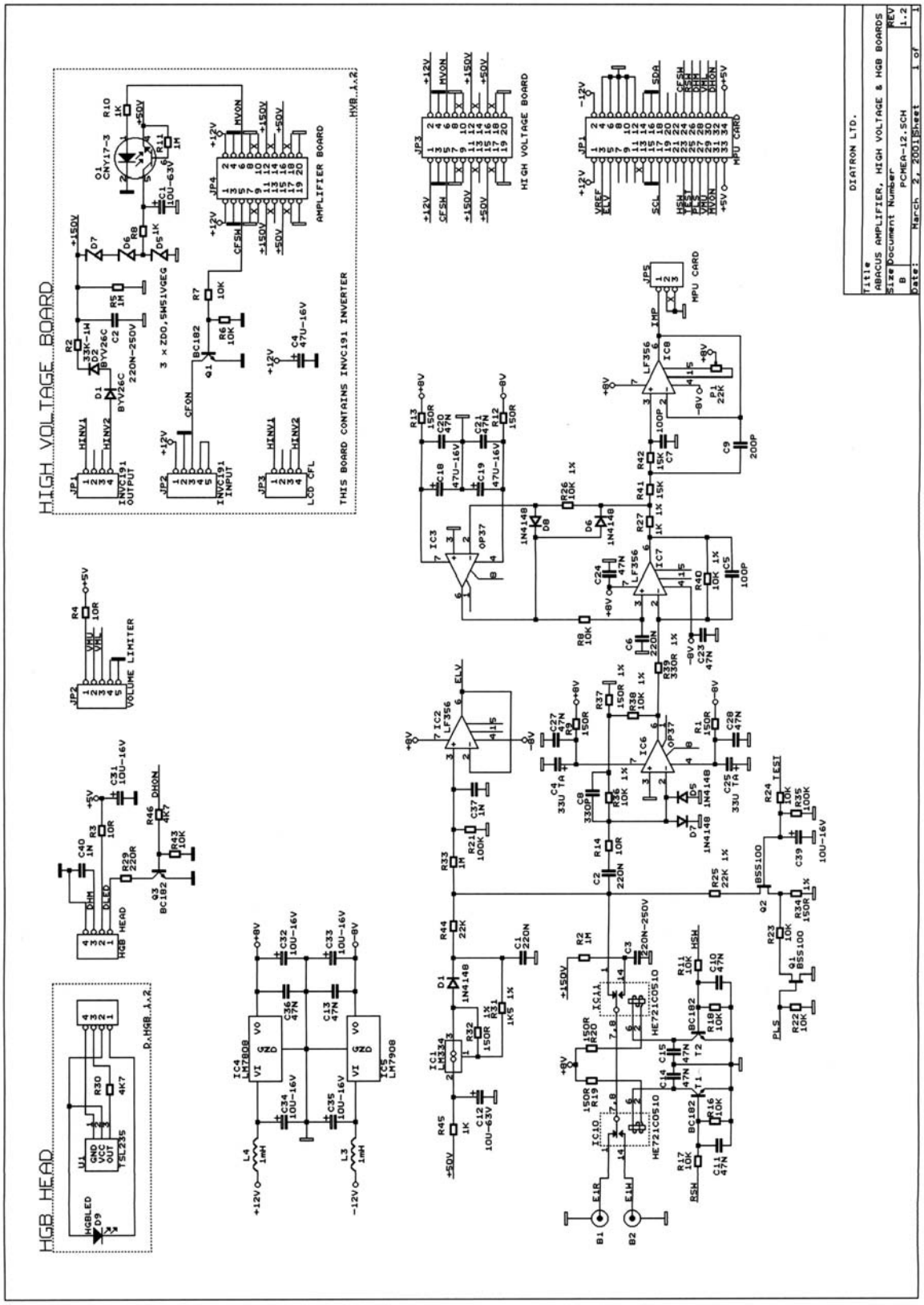
9.6 HUMACOUNT PLUS Cabling Diagram



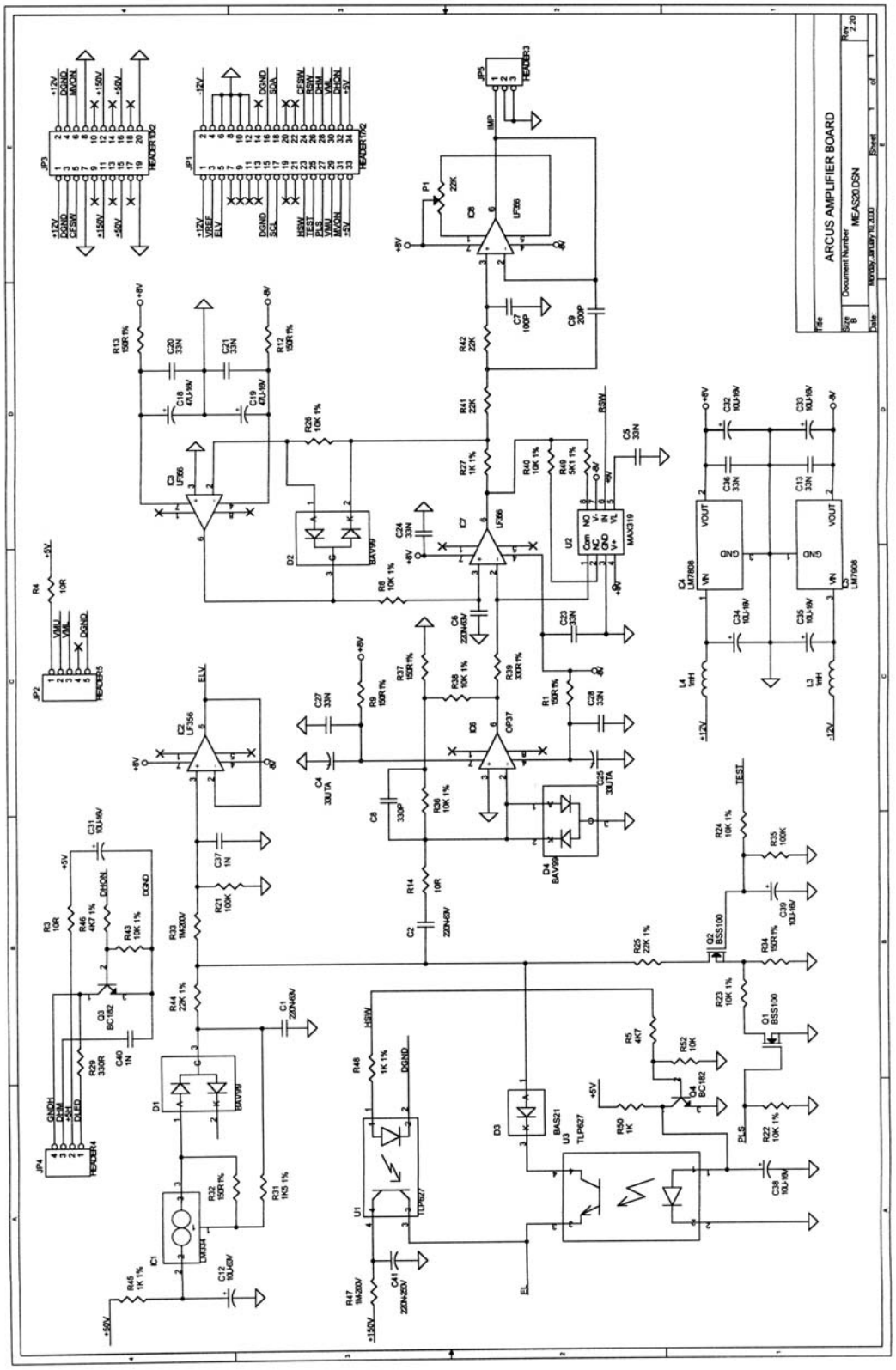
9.7 HUMACOUNT Cabling Diagram



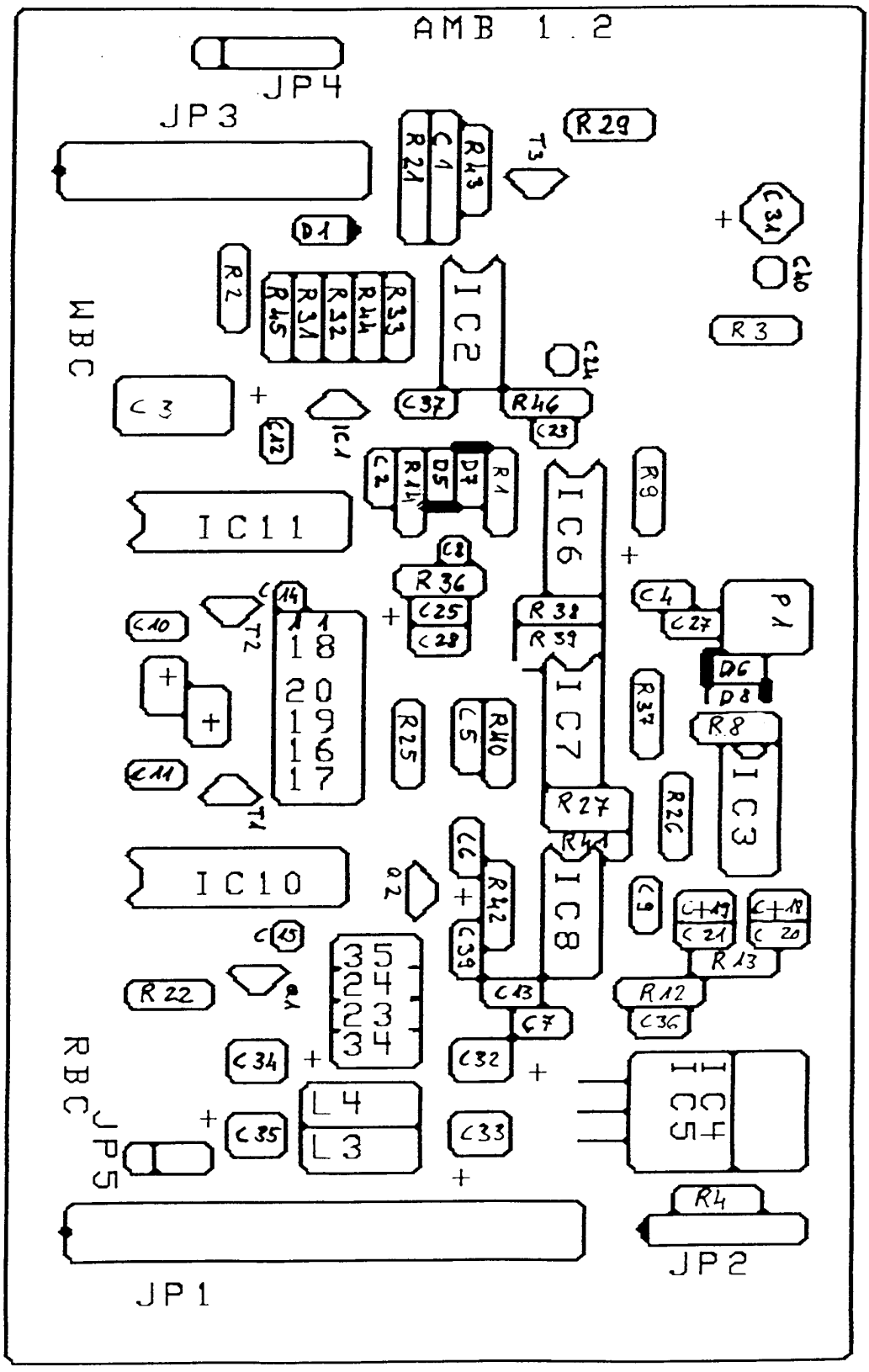
9.8 HUMACOUNT PLUS Amplifier, High voltage & HGB Boards



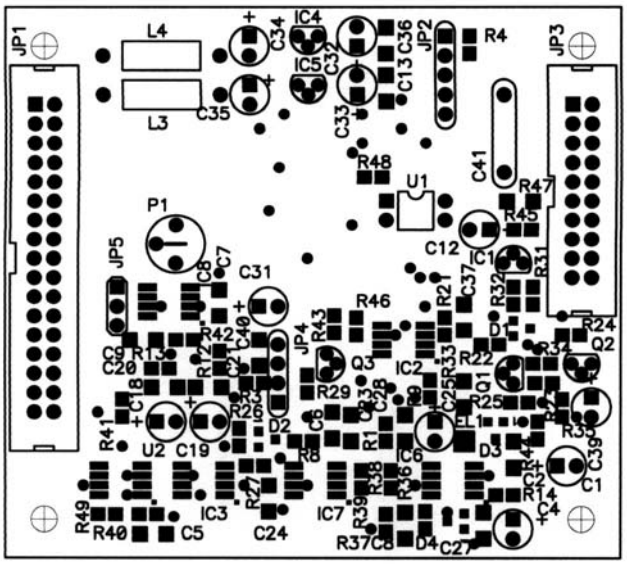
9.9 HUMACOUNT Amplifier



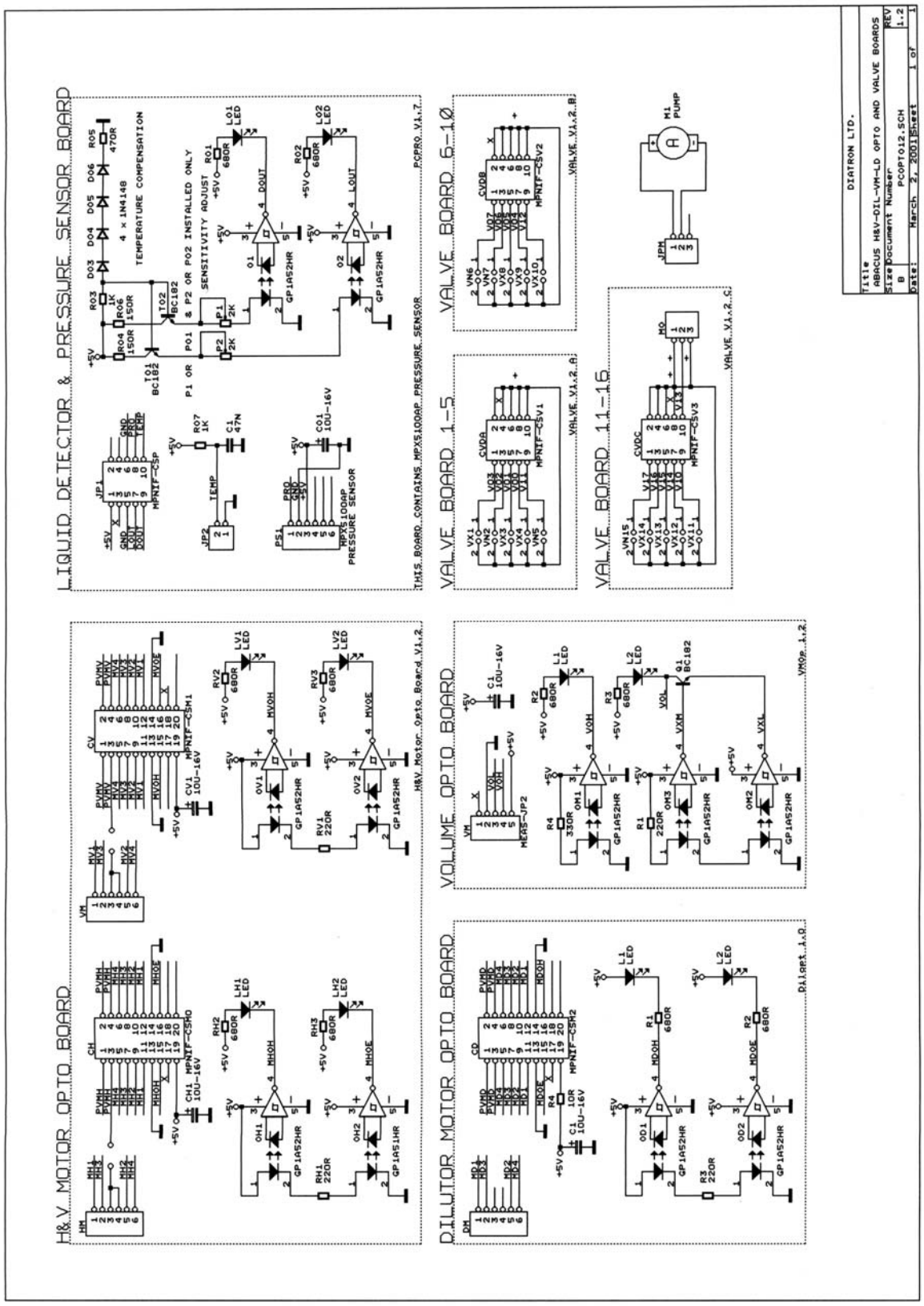
9.10 HUMACOUNT PLUS Amplifier PCB



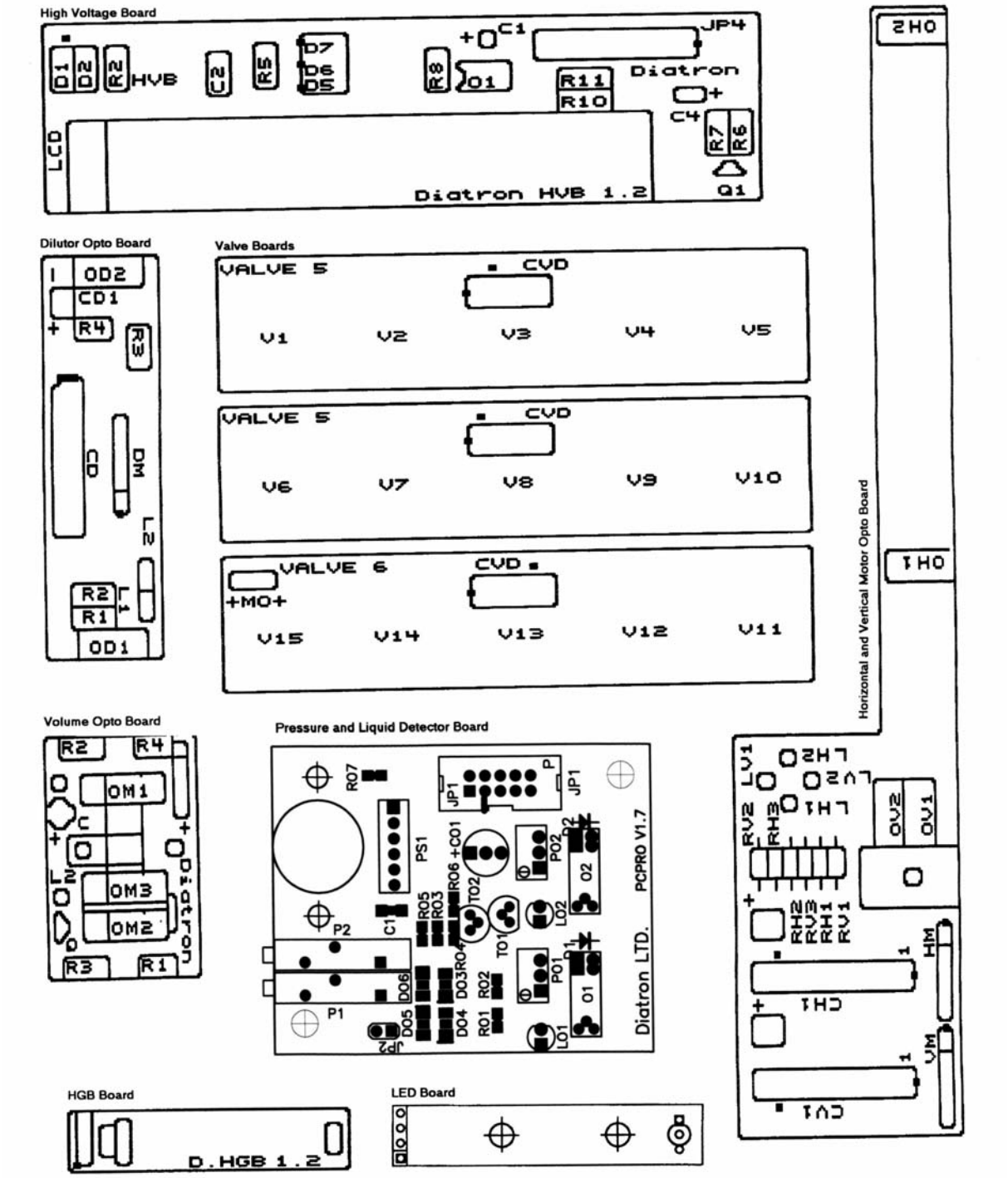
9.11 HUMACOUNT Amplifier PCB



9.12 H&V, DIL, VM, LD Opto and Valve Boards



9.13 Electronic part PCBs



9.14 Revision History

Rev. No.	Date	Person	Related section	Description
3.0	2004.06.01.	Hans B. Kern	All	Reviewed for new M/B

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01/2004-06